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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

Founded 1892. LONDON, JANUARY 14, 1915. VOL. XXXVII.

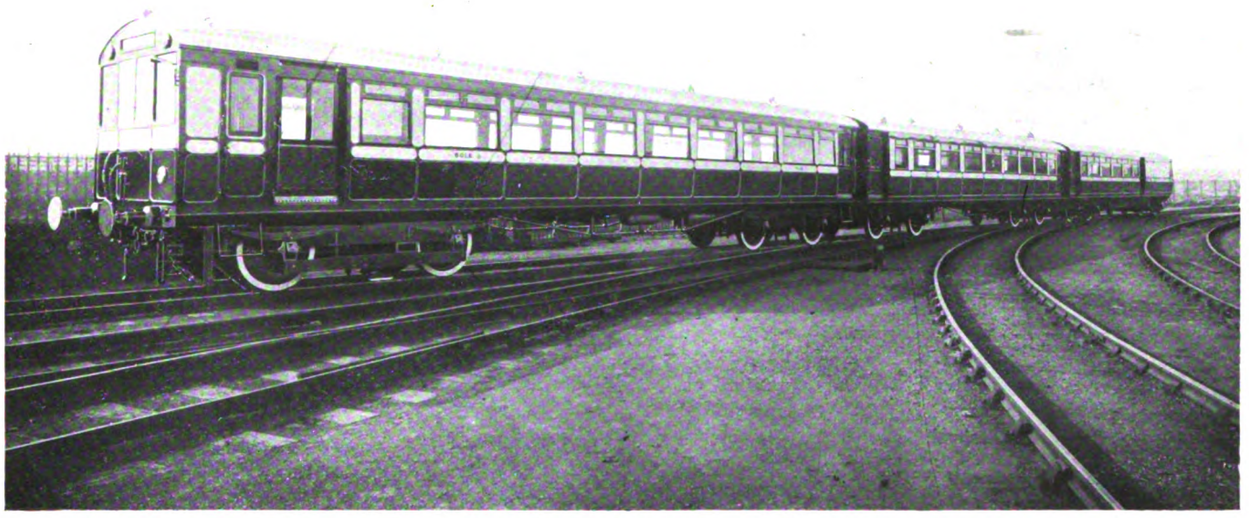
LONDON AND NORTH WESTERN RAILWAY ELECTRIC ROLLING STOCK.

TRAINS AT WORK AND UNDER CONSTRUCTION.

In our issue of May 7 last appeared an illustrated article describing the electrification work on the West London and West London extension railways, this being the first part completed of the large scheme for the conversion of suburban lines to electric traction now being carried out by the London and North Western Railway Company. The route is from Willesden Junction on the main line to Earl's Court station on the Metropolitan District Railway, a distance of $3\frac{3}{4}$ miles, and as two tracks have been electrically equipped, the length of single track is $7\frac{1}{2}$ miles. It may also be recalled that the route length of the whole scheme, including the new electric railway from London to Watford, and the extension of the Baker Street and Waterloo Railway from Paddington to Queen's Park, Willesden, is $41\frac{1}{2}$ miles.

The Willesden to Earl's Court line began to be worked electrically last spring, and pending the delivery of electric rolling stock trains belonging to the Metropolitan District Railway Company were used. The North Western Company's power-station at Stonebridge Park (west of Willesden Junction) was at that time far from complete, so a supply of energy was for the time being got from sub-stations of the Great Western and Metropolitan District Railway Companies. The Stonebridge Park generating station is now well advanced.

Four trains of three cars each (three trains for service and one spare) were ordered as a first instalment for the electrified line, and were delivered and put in service on the West London route during the past autumn, displacing the District Company's trains. When our article of May 7 was published only very brief particulars of the cars were obtainable, and these may now be supplemented. The trains were obtained from the Metropolitan Carriage, Wagon, and Finance Company, and each consists of a motor car, a trailer car, and a driving trailer car. The electrical equipment was supplied by Siemens Brothers Dynamo Works, Limited. Leading features of the vehicles (of which photographic views are here reproduced) are end doors and through communication. Both cross and longitudinal seats are fitted. The length of each car is 56 ft. 11 in. over headstocks. Each is carried on two four-wheel bogies, the bogie wheel base in the case of the motor cars being 8 ft. 9 in. and 37 ft. 6 in. centres. In the case of the trailer and driving trailer coaches the figures are 9 ft. and 38 ft. respectively. All wheels



Electric Three-Car Train now Running between Earl's Court and Willesden—London and North Western Railway.

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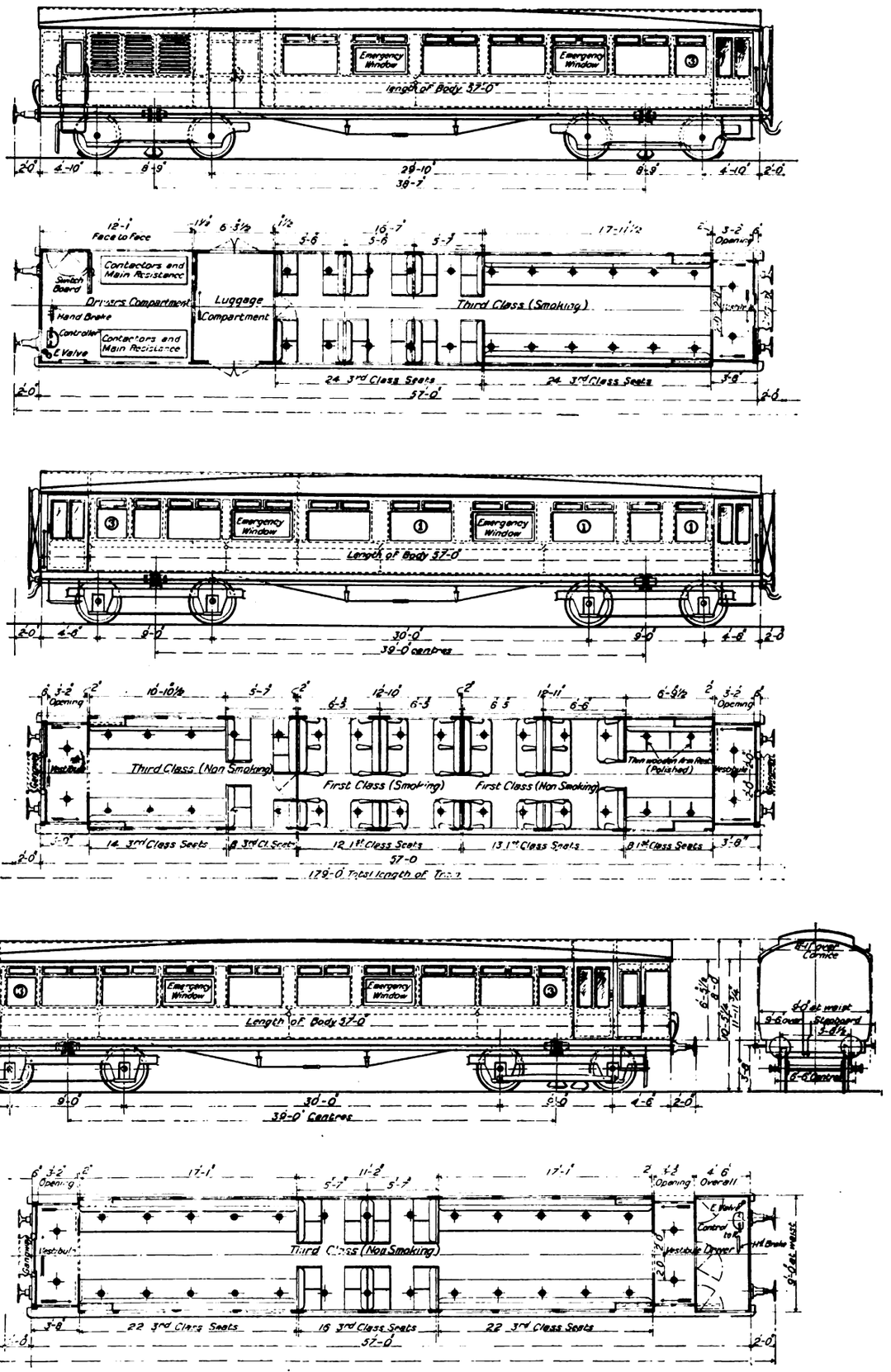

Plans and Elevations of Electric Three-Car Train,
London and North Western Railway.

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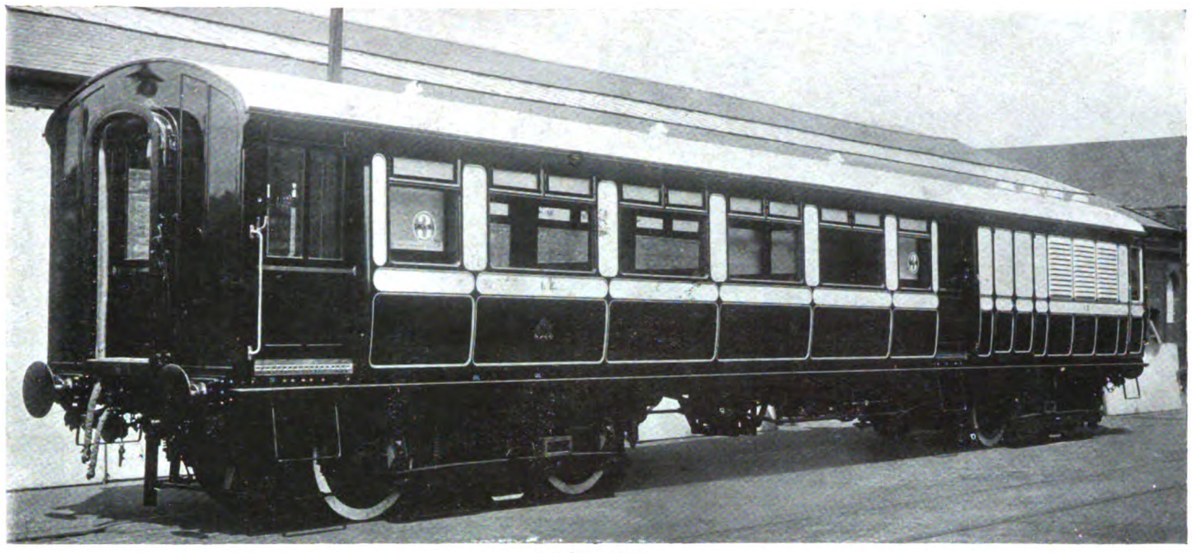
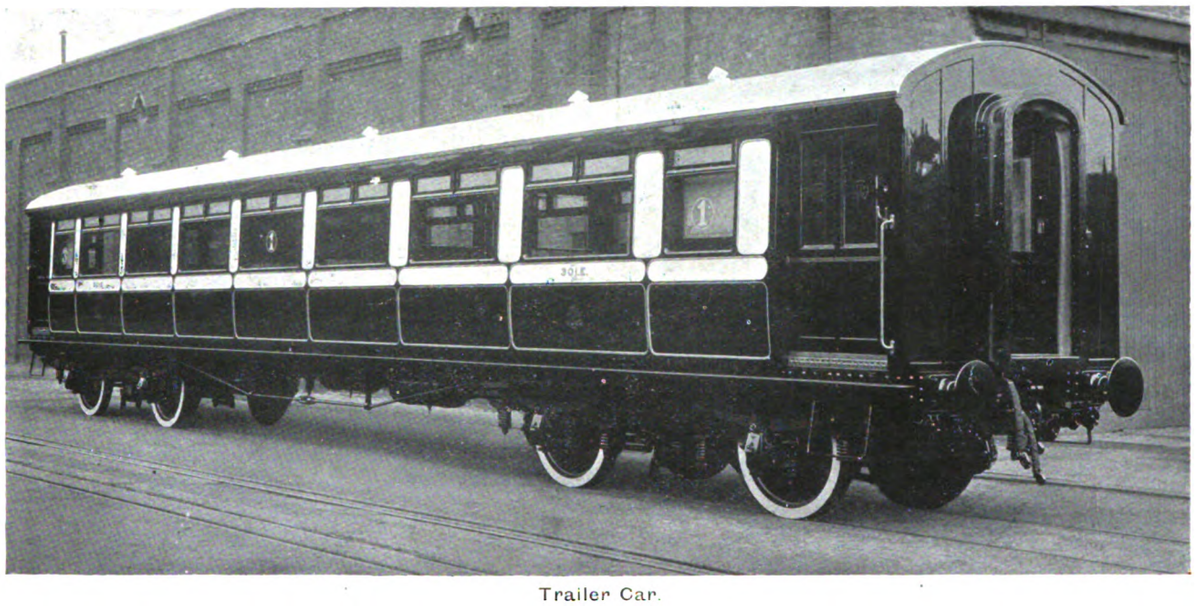
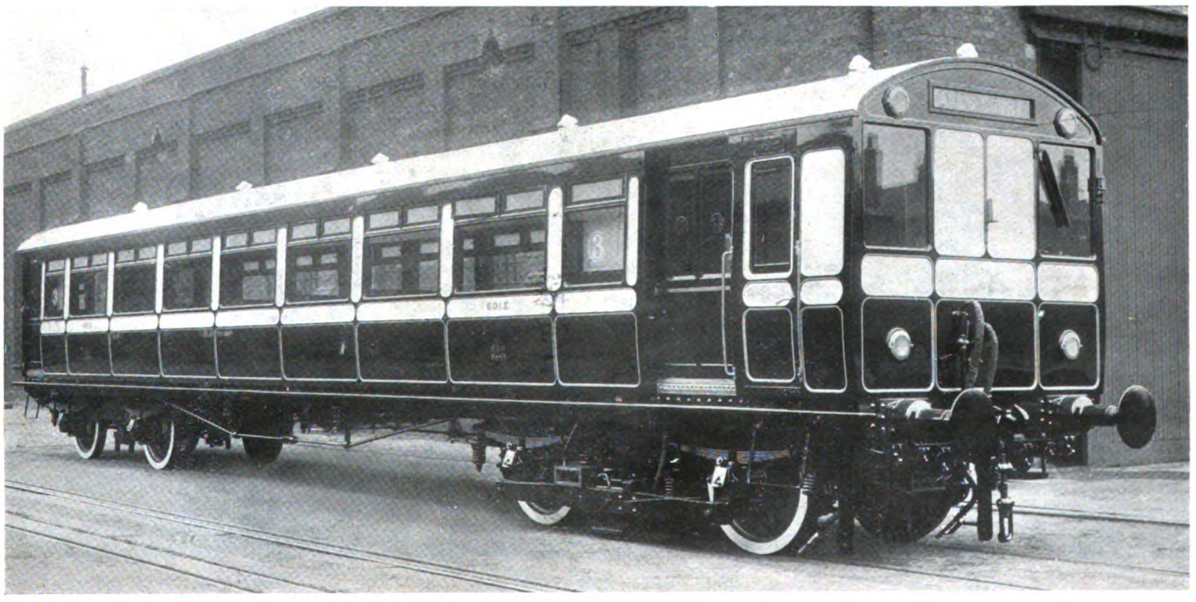


Motor Car.



Trailer Car.



Driving Trailer Car.

ELECTRIC TRAIN—LONDON AND NORTH WESTERN RAILWAY.

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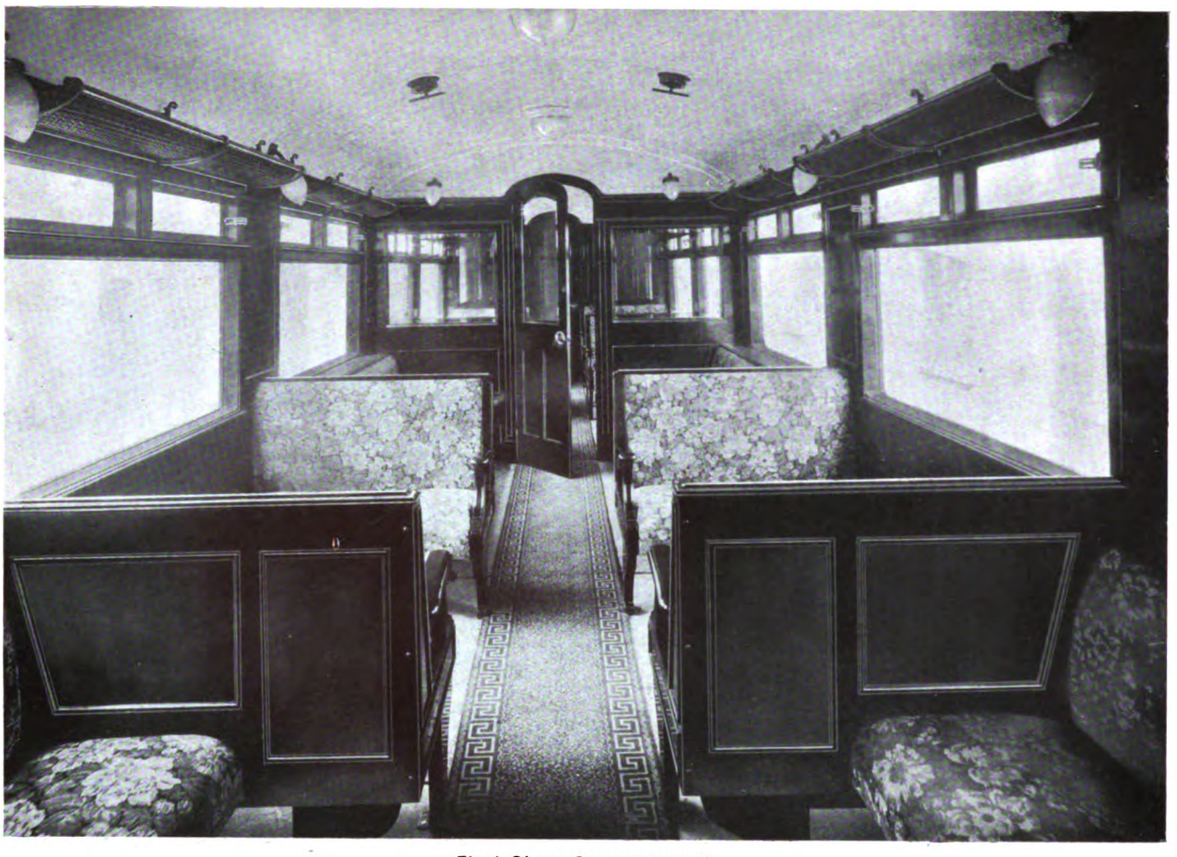

First-Class Compartment.

Third-Class Compartment.

INTERIOR VIEWS OF LONDON AND NORTH WESTERN RAILWAY ELECTRIC TRAIN.

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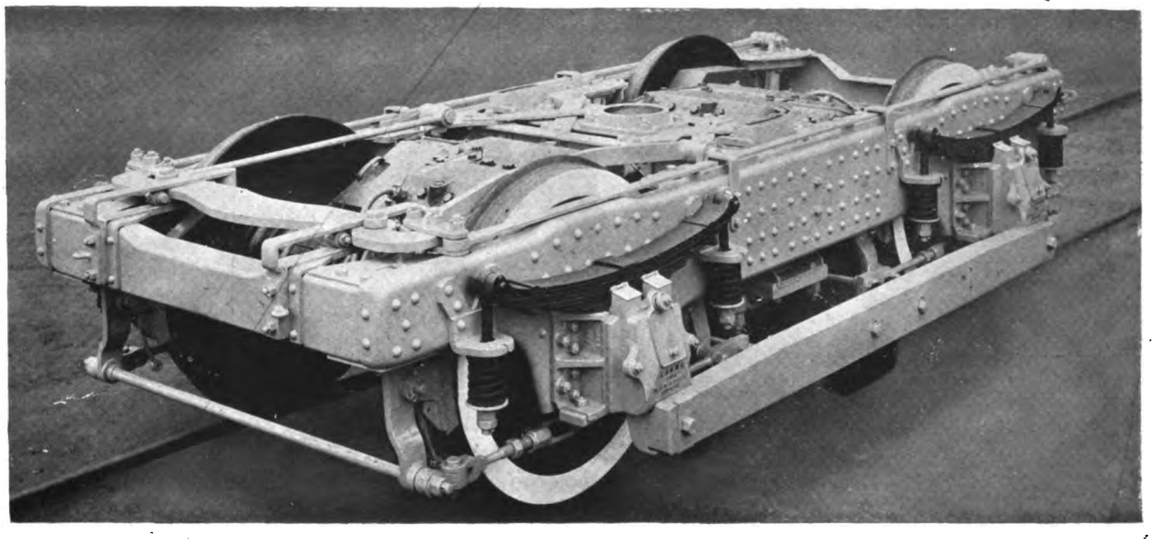
are 3 ft. 5 in. in diameter. The under frames of the cars are of steel, and the driving end of each motor car is built entirely of that metal. The interiors of the coaches are finished in polished mahogany, and the numbers of passengers for which seating accommodation is provided are respectively: Motor car, 40; trailer car, 66; driving trailer car, 60; total, 166. The lighting is by central and side-bracket electric lamps.

In regard to the electrical equipment, the multiple-unit system of control is used, and the control gear is contained in the driver's cab of the motor car, suitable connections permitting of driving from the driving trailer when the train is reversed in direction. In order to provide for rapid acceleration and a high running speed, each motor car is fitted with four motors of 250 H.P. each. To support these and to take the driving stresses, the bogie trucks are of specially strong design. Electricity is collected from the conductor rail by the usual sliding shoe, the current voltage being 600. The controller is fitted with a dead-man's handle. Automatic quick-acting brakes and hand brakes are provided. The air compressors on two of the trains are of Westinghouse make, and on the other two of the Knorr Brake Company's slide-valve type.



Pressed-Steel Electric Motor Truck—London and North Western Railway.

In addition to these trains in service, there are now on order for the other lines of the London and North Western Railway Company which are to be worked electrically, 43 motor cars and 76 trailer and driving trailer cars. The former are being built by the Metropolitan Carriage, Wagon, and Finance Company, and the latter by the railway company at their Wolverton works. They are of the same general style as the West London cars just described, and the detail arrangements are elucidated by the accompanying drawings. Normally the trains will consist of three cars each, but on most of the routes on which they will be employed the traffic is likely to be much heavier than on the West London, and whenever required two trains will be coupled together so as to form a six-car train.

Among points which may be noted in body construction is the fact that two emergency windows on each side of the car give an additional means of exit in case of fire. The exterior of the body is covered with steel panelling, and the wood of the roof is treated so as to be non-flammable. The floor is laid on corrugated troughing. The seating accommodation is: Motor car, 48; trailer car, 55; driving trailer car, 60; total, 163. The body length of each car is 57 ft. The bogie wheel bases and distances between centres are: Motor cars, 8 ft. 9 in. and 38 ft. 7 in.; trailers and driving trailers, 9 ft. and 39 ft. The four motors per motor car are of 250 H.P. each as in the former case, and multiple-unit control is employed.

VIENNA TRAMWAYS IN WAR TIME.

The New York *Electric Railway Journal* has received from Ludwig Spängler, manager of the Vienna Municipal Tramways, some interesting particulars of the effects of the war upon that undertaking. Writing several weeks ago, Herr Spängler says that at the outbreak of war the partial mobilisation of the Austro-Hungarian Army affected the personnel of the Vienna Municipal Tramways but slightly. At that time, in fact, not more than 800 out of 12,000 employees were called to the colours. In the course of the later mobilisation orders, however, they lost 4,650 men, of whom 3,100 were either drivers or conductors. At the same time the Government excused 2,500 of the older tramway men from army duty, in order that the service might be maintained. By calling upon men who had already been pensioned and by the more intensive efforts of the men who had been left behind, they were able, with a 45 per cent. reduction in the staff, to handle the 25 per cent. increase in business which occurred immediately after the heavy mobilisation period.

The instruction of new employees was taken up so quickly that by the end of October they had in hand 2,800 men. In November the car-mileage was 15 per cent. less than just before the war, and the gross earnings for October were 9 per cent. below those of October, 1913. Part of the reduction in earnings, however, was due to the great amount of free travelling granted to soldiers, who formed about one-seventh of the passengers. Another problem that the Vienna Municipal Tramways had to face because of the war was the great increase in freight transportation, due to the fact that the Army authorities commandeered so many horses and auto-trucks. Thus the tramways supply Vienna with all its milk, garden, and farm produce in connection with neighbouring interurban railways. The electric tramways are also being used very extensively by the Army to transfer supplies from large local warehouses to the steam trunk lines. In view of the hoped-for increase in traffic after the war, 135 motor cars and 125 trailers have been ordered. The order was given to save the workmen of the car builders from unemployment.

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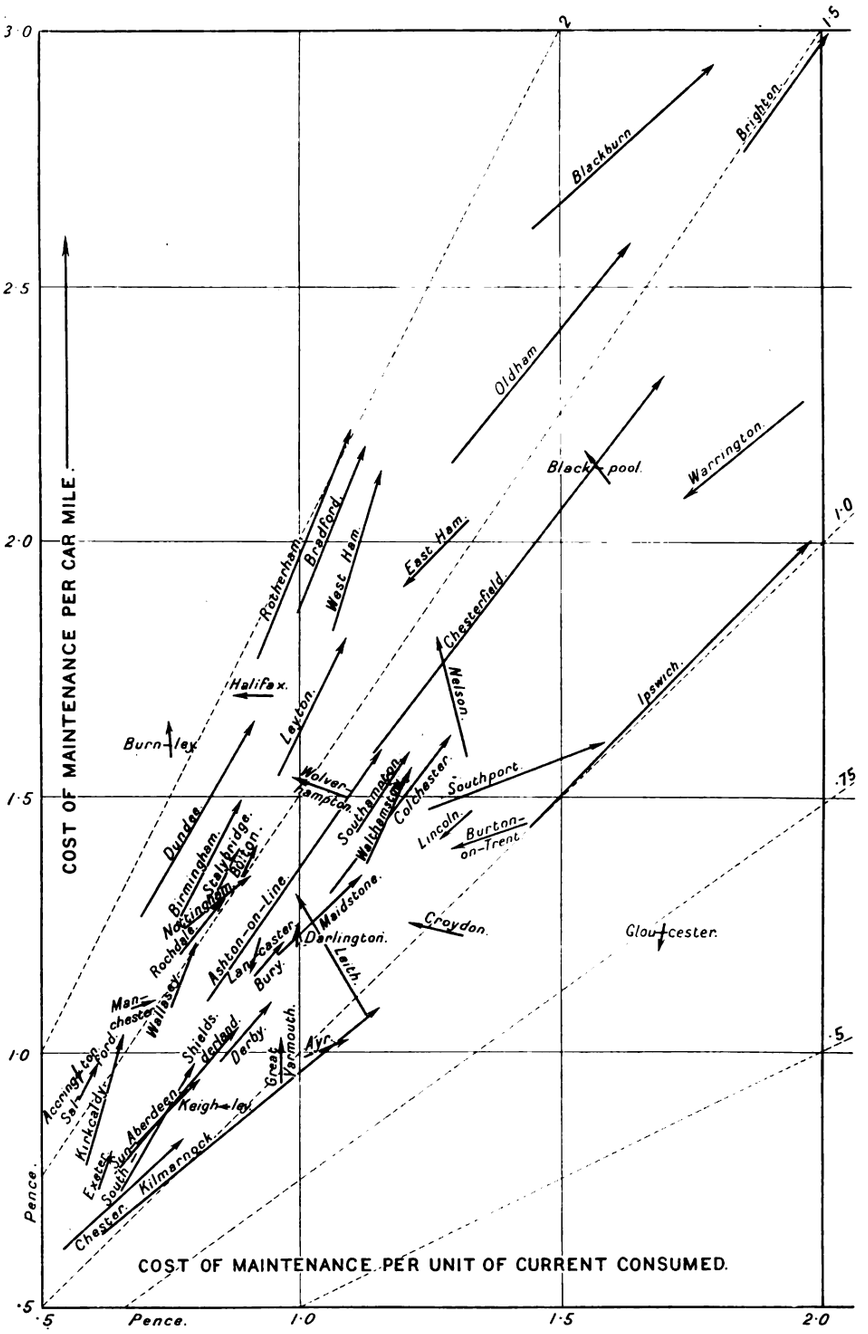
THE COST OF MAINTENANCE PER CAR-MILE AND PER BOARD OF TRADE UNIT.

By R. W. Western.

The accompanying diagram shows the cost of maintenance per car-mile, and also per unit of electricity consumed, for the municipal tramway undertakings in towns where the generating station also supplies current for general lighting purposes. The graph has been plotted from the figures given in the tabular records of this journal of electric tramway accounts for the two last years of account. For some few of the cities the figures of the year ending in March, 1914, are not yet available, and these cases, for the sake of uniformity, have been omitted. For the same reason towns having a separate generating station for traction purposes are not included, and it is to be borne in mind that in the cases illustrated expenditure on maintenance does not comprise the expense of maintaining the generating station, the cost of this being paid for in the charges to be met for energy supplied. It will be seen that the cost of maintenance per car-mile is measured vertically in pence according to the figures given on the left side of the diagram, while the cost of maintenance per unit is measured horizontally, also in pence, the figures for which are given on the lower edge of the diagram. In addition, there are diagonal dotted lines showing the units consumed per car-mile. The position for each town is marked by an arrow, of which the point fixes that for the last year of account, and the head that for the previous year.



There are many advantages in thus presenting some salient aspect of tramway management as practised in a number of tramways undertakings, so that features common to them can be quickly and easily apprehended. Perhaps the most striking feature in this presentation is the uniformity in the direction of the arrows. Scarcely any are to be found pointing downward towards the left-hand bottom corner of the paper, indicating that expenditure on maintenance, whether gauged by the car-miles run or the electricity consumed, has been greater in nearly every case during the last year than for the previous year.

Most of the towns comprised inaugurated their electrical tramway systems between 1900 and 1904, and actual expenditure on maintenance was naturally smaller in early years, when the bulk of permanent way and rolling stock were new, than proved subsequently necessary as the average age of the various parts advanced. As a rule, the portions of the permanent way first laid down are those which have borne the densest load of traffic, and we are now approaching the time when the early lightness of maintenance charges produces the necessity for correspondingly heavy expenditures for renewals. Of course, in soundly financed undertakings, a depreciation fund has been provided to meet the cost of such renewals, but where this provision has been inadequate the defect is likely to be supplied to some extent by increase of the expenditure charged annually to general maintenance. The great differences between the amount of the maintenance cost in the various tramways embraced in the diagram suggest either that those responsible for the financial policy of the tramways do not deem it desirable to make the expenditure on maintenance as uniform as possible from year to year, or that much has yet to be learnt in tramway engineering as to the probable dates at which heavy renewals become necessary. The inclination at which the arrows take their upward flight is in most instances the same as that of the dotted lines which

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traverse the diagram diagonally, showing that the consumption of current per car-mile underwent little change, as a rule, during the interval reviewed. Exceptions such as those at Leith, Nelson, and Blackpool are nearly all in the upward direction, and thus indicate a tendency to increased speeds, increased loads, and (or) more frequent stoppings in these localities. Of the basis for estimating or comparing the cost of maintenance in various undertakings, here brought into relation, the car-mile is in common practice alone employed to the neglect of that afforded by the unit of current. But when it is remembered that a car may be big or little, move fast or slow, and stop often or seldom, while a unit of electricity employed in traction is, in either of these alternatives, equally expended in wearing out the line and the rolling stock by friction and vibration, it will be recognised that there is much to be said in favour of estimating the cost of maintenance from data furnished by the current consumed rather than by the car-miles run. If the diagram be divided by two diagonals to form a St. Andrew's Cross, it will be divided into four parts each of triangular shape, and comparisons may be instituted on the following lines:

Maintenance is high in the right-hand triangle and in the top triangle, but whereas in the latter the consumption of current per car-mile is large, pointing to high speeds, heavy cars, and (or) much stopping, in the former these reasons are wanting, and the explanation may be that the management is making good past defects or preparing to face future possibilities of deterioration with a large reserve of serviceable fitness.

In the left-hand and bottom triangles maintenance is low, but whereas in the former this may be sufficiently accounted for by the fact that the current consumption per car-mile is small, implying small cars, at low speeds and (or) infrequent stops, to the latter these reasons are inapplicable, and the explanation may be that the management is reposing upon the accumulated merits of past years, during which the line and rolling stock have been brought to a superlative state of fitness, or it may be that extensive renewals are imminent, and that ordinary maintenance charges are more than can be profitably expended upon plant about to be discarded.

PRICE OF EDINBURGH TRAMWAYS.

The offer of the Edinburgh Tramways Company to sell their undertaking to the Corporation for £250,000 has been declined by the committee, and unless some change takes place in the meantime the company will continue to work the tramways until June 30, 1919, when their lease expires. Although the company offered to sell the undertaking for £250,000, they valued it at £292,000, which sum is made up as follows:

	£
(*a*) Value of cash and investments at estimated market value, less interest on debentures accrued, outstanding accounts, accrued rent and taxes, and dividend due on December 13, 1913, and since paid	23,737
(*b*) Tramway cars at cost	110,497
(*c*) Carts and motor vehicles, office furniture and fittings, horses, machinery, working plant, tools, and utensils—cost £10,733 ..	6,762
(*d*) Property at 1, South Charlotte Street, at cost	1,833
(*e*) Stores on hand, including unexpired value of cables... ...	46,553
(*f*) Profits for four years, based on an average of six years, after deducting amount arranged to be spent on renewal of lines, capitalised and reduced to present value...	92,926
(*g*) Directors' fees for four years, capitalised and reduced to present value	7,434
(*h*) Increased advertising rent, £750 per annum for four years ..	3,000
	£292,742

It was pointed out in a letter which the company sent to the Town Council that the directors have entered into a favourable contract for the supply of cables up to the end of their lease, and they have stipulated that, in the event of the Corporation acquiring the tramways at an earlier date, the latter are to have the benefit of that contract. They have made a similar arrangement with the insurance company in which they are insured against third-party and every other risk.

DEVONPORT TRAMWAY ACCIDENT.

BOARD OF TRADE INQUIRY.

On November 27 a car on the Devonport and District tramway system overturned at the bottom of an incline and two passengers were killed and over 30 injured. The scene of the accident was a curve at the foot of a gradient leading from St. Michael's Terrace to the Technical Schools, and the car was used for conveying workmen. It appears from various statements that the car got out of control while descending the hill, and was running at such a speed that when it reached the bottom it left the rails when rounding a curve and overturned. A similar accident occurred at the same place several years ago. Since that time the tramway company obtained land which enabled them to widen the road, and the curve was made less sharp and the outer rail was given more super-elevation. Recently the track was relaid with new rails.

The Board of Trade inquiry into the accident was held on December 3, when Mr. George Cardwell, engineer and manager of the Devonport and District Tramways Company, stated that he had examined the car, which had overturned at the bottom of a hill. He found that the wheel brake was fully on, and the brake chain quite tight. The foot ratchet pawl was in position, holding the brake blocks on to the wheels. The track brake was off, and the brake chain was quite slack. The handle of the controller was at the "off" position, and the electric emergency stop was fully on. There were distinct flats on the two rear wheels, and the wheel tires showed burning. There were signs of small flats on the two front wheels. In the past he had found that the brakes employed controlled cars quite satisfactorily. His opinion as to the cause of the accident was that the car approached the curve at the foot of the hill with locked wheels, and consequently refused to negotiate the curve, with the result that it turned over. There were no signs of any scores on the setts, which the wheels would make if the car had jumped the line. The car had been in use for 10 years, but it was reconstructed in 1912, and so far as he could judge was one of the best conditioned cars on the system.

Alfred Cheek, the driver of the car, said that he had been a motorman for about 18 months. He noticed the car getting out of hand, so he applied the emergency brake and the hand brake, and used the sand box. The emergency brake nearly brought the car up at the bottom, and he had no doubt as to the efficiency of the brakes at the time. He also applied the slipper brake at the top of the hill.

William Riley, the conductor, stated that he noticed that the car had passed a Board of Trade stopping place, and was gathering speed as it neared the bottom of the hill, but it slowed up, and was not going very fast when the curve was reached, but it toppled over.

Mr. A. W. A. Chivers said that he had examined the car, and in his opinion the accident was due to the car having run away. He thought that the driver probably allowed his car to travel at a speed in excess of that allowed by the Board of Trade, and that when he attempted to make the Board of Trade stop at Trafalgar Road he probably locked the wheels, and the car commenced skidding. He appeared to have persevered with the brakes, and, judging from the reported speed of the car at the curve, he probably reduced the speed at the bottom of the gradient to something slightly above that authorised by the Board of Trade. If that was so, and the wheels had not been locked, the accident would probably have been avoided.

After other evidence, Colonel Druitt, who held the inquiry on behalf of the Board of Trade, adjourned the proceedings, and his report will be issued in due course.

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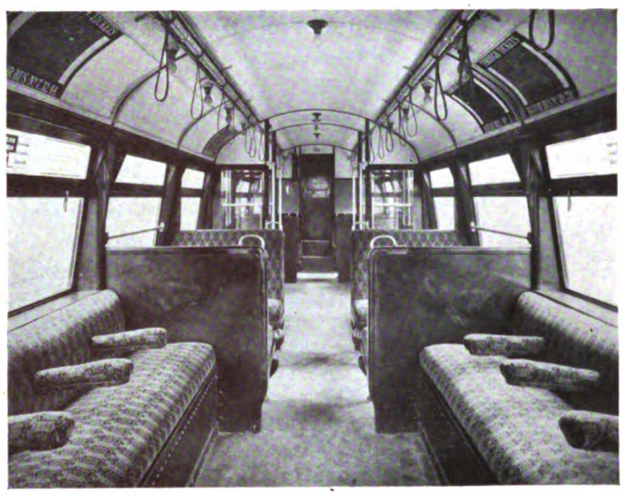
LONDON ELECTRIC RAILWAY CARS.

NEW ROLLING STOCK FOR THE "BAKERLOO" LINE.

The opening of the extension of the Bakerloo line of the London Electric Railway from Paddington to Queen's Park has necessitated the introduction of new rolling stock. This additional stock consists of one four-car train, comprising two motor cars and two trailer cars built by the Leeds Forge Company, and of seven motor cars which have been made up by the London Electric Railway Company in their workshops at Golder's Green, by converting existing trailer cars into motor cars.



Interior of Car Built by the Leeds Forge Company.

The cars built by the Leeds Forge Company are of a peculiarly interesting design. As was the case in the cars built for the Bakerloo by the Brush Company, which were put into service early in 1914, and which were described in our issue of March 12, 1914, the cars are fitted with centre doors to facilitate the handling of passengers at busy stations. It may be well to recall the fact that these doors are automatic in action, under the control of the gateman. On the grill work at the gateman's end of the car is fitted an indicator box containing a red and a green lamp. When the gateman opens his gate, he automatically unlocks the middle door, and lights up the red lamp. The middle door is of the swing variety, and opens inwards. The middle door is self closing by means of a Bardsley door check mounted under the floor, and is opened by passengers as required. When the gateman closes his gate, if the middle door is closed, the electric lock shoots its bolt, and a green lamp lights up, indicating that the middle door is shut and bolted. If, however, the middle door is still open when the gate is shut, the red light persists until the door is closed. In the drawing the car is shown as being fitted with twin middle doors. Since delivery, however, these twin doors have been replaced by a single door 2 ft. 2 in. wide, as it has been found in practice that passengers use only one side of the twin doors, and the opening of one of the twin doors gives hardly enough clearance. In the photograph reproduced herewith one of the motor cars is shown fitted with the single swing door.

These cars are of an all-steel construction, the only timber being found in the new single swing doors. The weight of the cars, however, has been kept low, the weight of the trailer car complete with trucks being 17 tons 15 cwts., and of the motor car complete with motors and all equipment, 27 tons 10 cwts. These weights compare favourably with those of any of the cars on the London Electric Railway, and are considerably less than those of the original Bakerloo stock. The cars are seated with woven wire seats covered with moquette supplied by the Longford Wire Company. The interiors are finished in a dark terra-cotta and cinnamon combination, with the result that a warm appearance is obtained, notwithstanding the all-steel construction.

Much of interest is to be found in the motor cars which the railway company have constructed out of trailer cars. A body framing drawing of the motor cab end of the car is reproduced herewith. Owing to the limited space available in these tube railways—the cars stand only 9 ft. 5 in. high from rail level—there is no room under an ordinary trailer car for a motor truck and motors, nor is there room to hang the control equipment under the floor of the car, as is usually done in surface railways. The result is that at the motor truck end of the car, the floor level has to be raised considerably to allow of the introduction of the motor truck, and, owing to the consequent restricted head room in the motor cab, that portion above the motor truck, is utilised for the contactors and necessary

View of Motor Car Built by the Leeds Forge Company.

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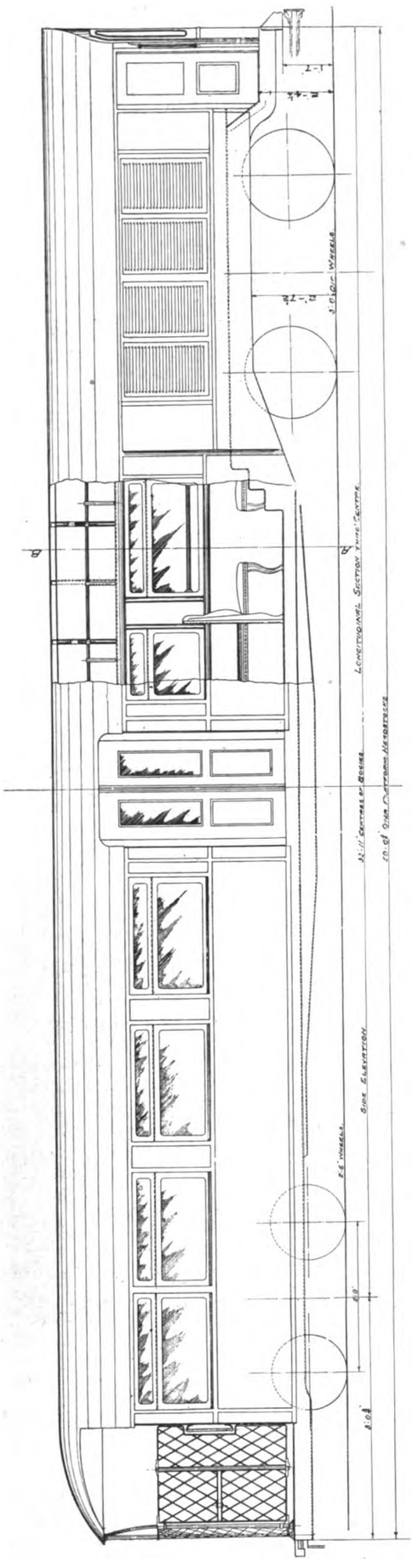
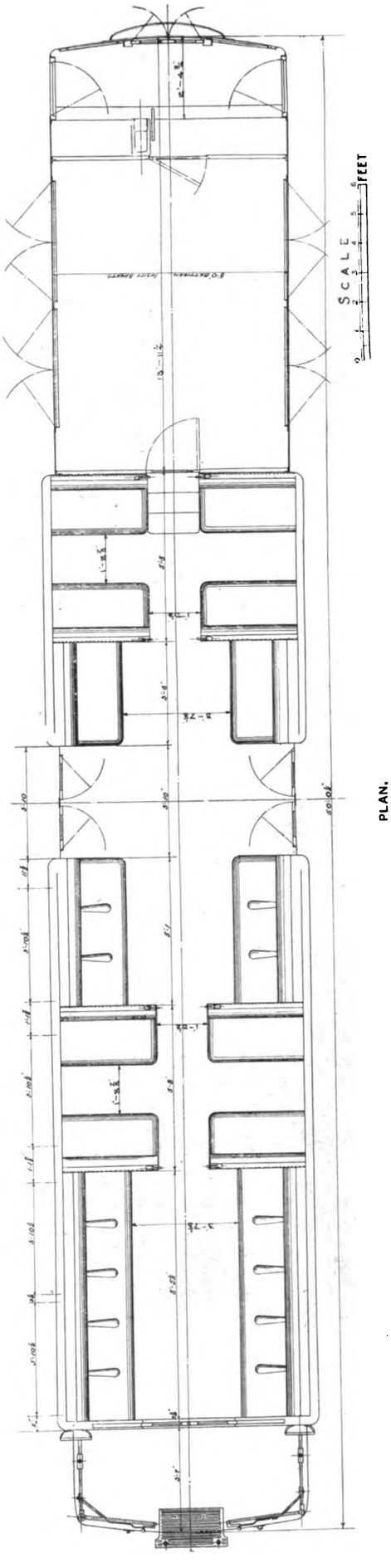


ELEVATION.



PLAN.

Motor Car Made by the Leeds Forge Company.

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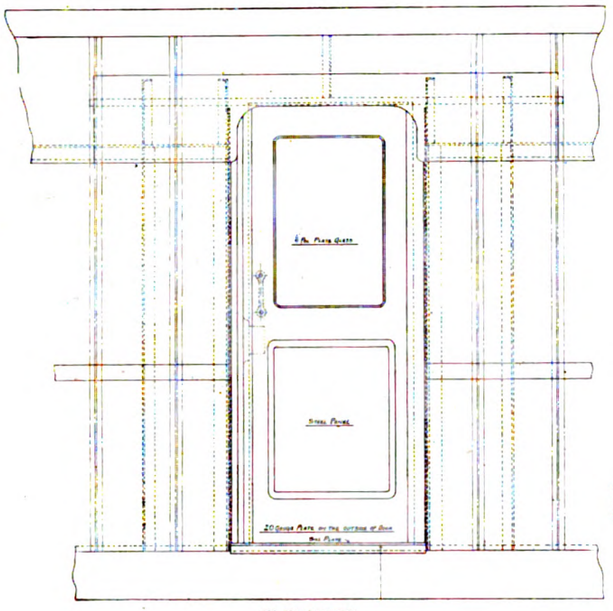
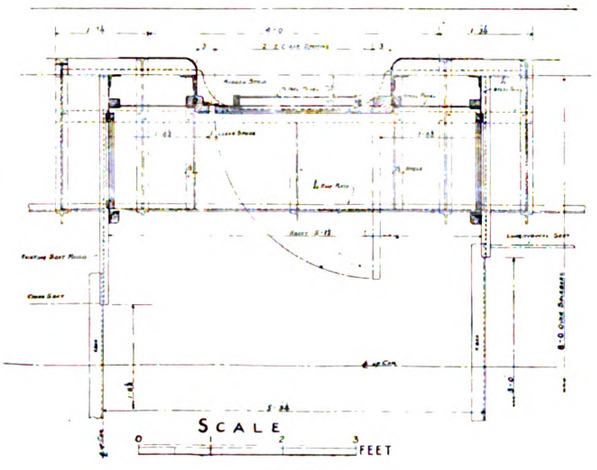
equipment. The trailer cars, of course, which have been converted into motor cars had a horizontal floor throughout their length 1 ft. 10 in. from rail level, the bottom of the sole bar being 1 ft. 2 in. from rail level.

Accordingly, about 16 ft. from the front of the trailer car end, the under frame and belt rail were cut through, the roof members being left. Special sole bars of 4 in. by 4 in. by $\frac{7}{16}$ in. angle to bridge over the motor truck were fitted, being riveted to the end of the original sole bar through the medium of a small sturdy steel casting angle piece. A new belt rail was also fitted in this extension, and then a heavy $\frac{3}{8}$-in. side panel was riveted between the sole bar and the belt rail. The effect of this is that the new cab is joined to

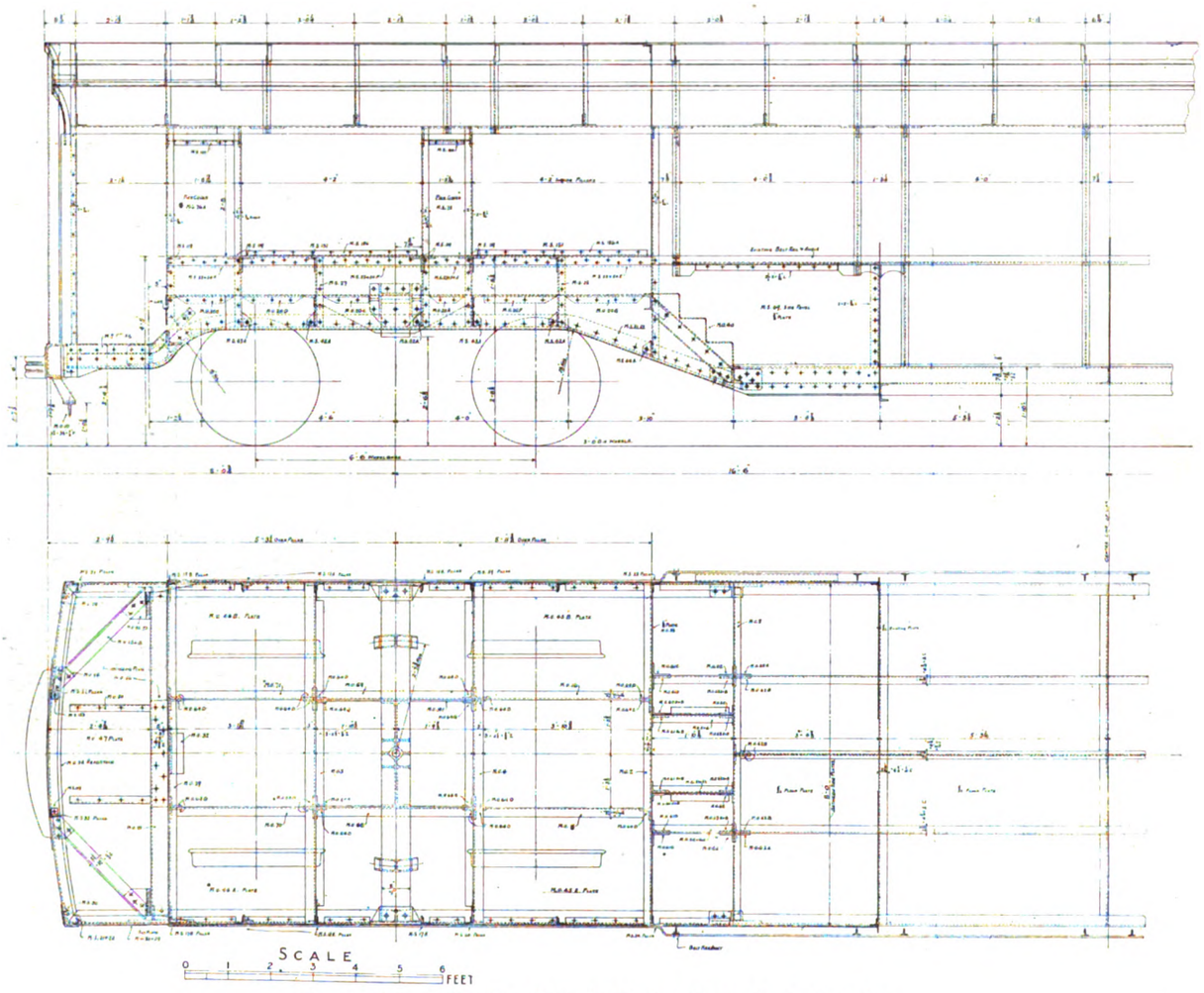


ELEVATION.



PLAN.

Conversion of Trailer Cars to Motor Cars—Hinged Centre Doors.



Conversion of Trailer Cars to Motor Cars—Body Framing.

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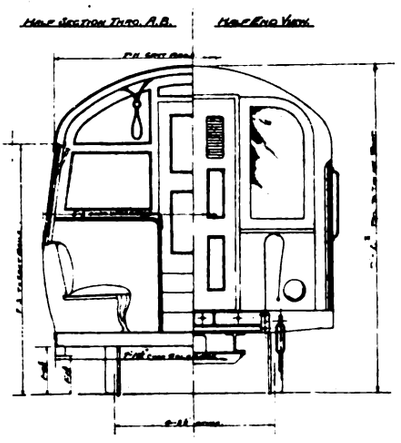
the old part of the car by a plate girder on each side 3 ft. 2¼ in. deep at the point of junction. These side panels, together with the extension of the middle longitudinals, ensure ample strength at the point where the new cab meets the old car body. The rest of the construction of the cab is of a straightforward character, as may be seen from the drawing on page 21. Although we are unable to reproduce a photograph of these converted cars, their appearance is hardly distinguishable from the standard motor car now running on the London Electric Railway, as the monitor roof has been retained.

The trailer cars chosen to be converted into motor cars have an exceptionally strong under frame, the sole bars being heavy 7-in. bulb angle irons, and it has been found possible to fit centre doors to these cars without any radical alterations to the design of the car. The panels in the middle of the car have been cut out and centre doors fitted. A drawing is reproduced showing the construction at this centre door. The whole of this work has been carried out to the designs and under the supervision of Mr. W. A. Agnew, the company's mechanical engineer, to whose courtesy we are indebted for the information given.



End View of Motor Car by Leeds Forge Company.

METROPOLITAN RAILWAY DEVELOPMENT.

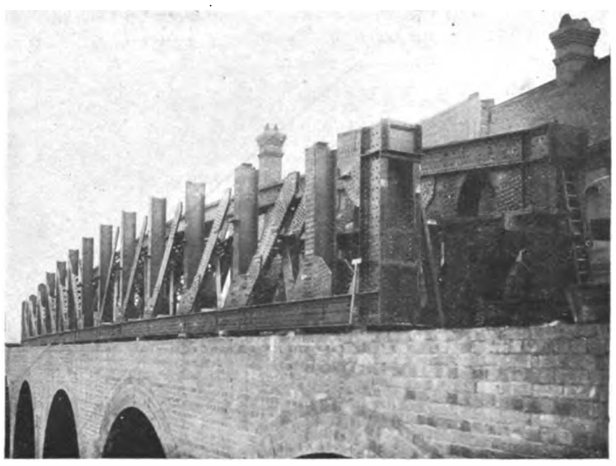
New Viaduct at Kilburn.

The laying down by the Metropolitan Railway Company of a new express line for electric trains on the route between Baker Street and Harrow, entailed the construction of an important new railway viaduct at Kilburn. The widening of the railway track commenced with the demolition of two tunnels at Finchley Road. From this point the railway branches from four to eight rails, and the traffic is divided here into local and express trains.

Most of the new line has been laid on land belonging to the Metropolitan Railway parallel with the existing lines, but between West Hampstead and Kilburn stations it was necessary to construct a lofty viaduct, passing over the London and North Western Railway lines and a number of streets and thoroughfares. The viaduct, without approaches, is over one-third of a mile in length, and forms an engineering work of considerable magnitude. The works were started in June, 1913, and are expected to be completed shortly.

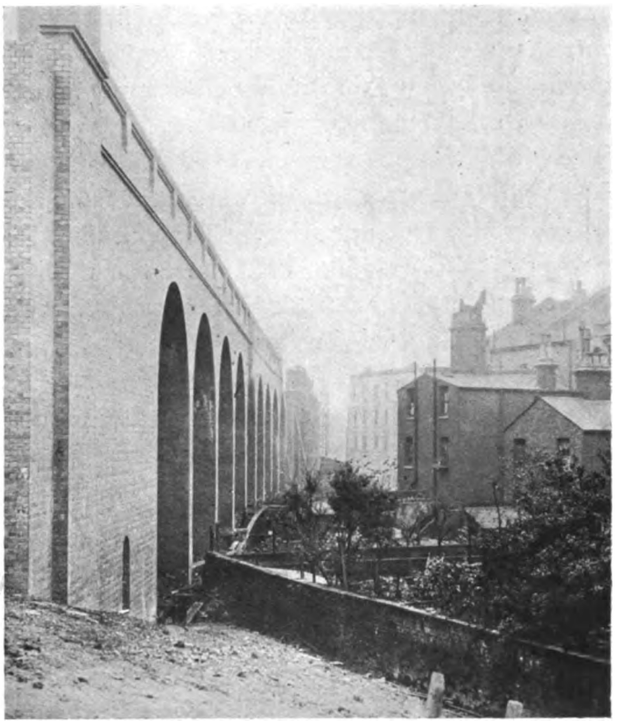
The viaduct works include the construction of four bridges, details of which are as follows: The bridge over the London and North Western Railway, built on the skew, has two clear spans of 97 ft. and of 80 ft., the girders being 7 ft. 6 in. at ends and 9 ft. 6 in. in centre. The bridge is of the hog-back plate type with pressed trough flooring. The total weight is about 300 tons. The bridge crossing Iverson Road weighs about 300 tons, and is of the hog-back lattice type, having a clear span on skew of 99 ft. with plate flooring. The girders are 8 ft. 6 in. at ends and 13 ft. at centre of bridge. The bridge crossing Loveridge Road has a clear span of 80 ft. between the bearings. It is of the lattice type with plate flooring, and girders 10 ft. 6 in. at ends and 13 ft. in centre, the weight being about 180 tons.

The largest bridge, that at Kilburn High Road, which weighs about 600 tons, has a clear span of 147 ft. centre and



Viaduct at Kilburn.

37 ft. at the ends. This bridge is also of the lattice type with plate flooring, the girders being 11 ft. 6 in. at ends, and 15 ft. 6 in. at centre. The end spans are 10 ft. 6 in. deep. This bridge will have a cast-iron ornamental parapet 7 ft. above rail level. All the railway lines will be carried over the bridges on ballast.



Viaduct at Kilburn.

Mr. W. Willox, chief engineer, Metropolitan Railway, is responsible for the work. The contractors for the bridges over Kilburn High Road and Loveridge Road are Messrs. E. C. and J. Keay, of Darlaston, and for the bridges over Iverson Road and the North Western Railway, Messrs. Eastwood, Szwingler, and Company, of Derby, under the superintendence of Mr. O. G. C. Drury, resident engineer.

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THE
Tramway and Railway World

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LONDON, JANUARY 14, 1915.

The Past Year.

The year 1914 was probably the most chequered which has ever been experienced since British tramway annals began. For the first seven months most of the undertakings showed a comfortable and some an abounding prosperity, as measured by the growth of traffic receipts. The chief exception was the tramways in the Metropolitan area, which were still suffering from omnibus competition. Then at one fell stroke in the beginning of August the position was changed. The outbreak of war to a certain extent disorganised business, affected finance, and produced general uncertainty. Traffics, accordingly, went down. Then great numbers of tramway employees joined the colours, services were reduced, new men had to be trained and paid in addition to the allowances to the men who had joined the army. In some directions it has been found possible to reduce expenses, and it need not be anticipated that the net financial results of the year will prove disastrous. In some districts, of course, the effects of the war have had little adverse result on tramway receipts, as local industry has been stimulated by military demands. Again the case of London is remarkable, as the various tramway undertakings show large increases in receipts owing to the reduction in omnibus competition. This, again, has been brought about by so many omnibuses having been requisitioned by the War Office. Matters generally have so settled down that the future may be regarded with considerable equanimity. As to the position of manufacturers and contractors in the tramway field, there seems to have been some slackening in orders where these can be postponed, but in most cases business has gone on. Then, if the whole truth were known, it would probably be a surprise to learn how large a number of manufacturers of tramway material and supplies have found that they were able to adapt themselves and their works to the production of war material at good prices. As to prospects of new tramways being authorised, the number of proposals to come before Parliament this year is naturally more limited than usual. Such suppression, however, ought to lead to the greater activity as soon as peace is declared, and a general boom in trade sets in. On the whole, British tramways seem to have suffered far less than most of those on the Continent. It may be some comfort to reflect that even in the United States there is much financial trouble in the tramway field, partly on account of the war, and partly because of restrictive legislation. Receipts are not what they should be, and the difficulty of raising new capital for extensions appears to be growing.

Rear Lights on Vehicles.

Reference is made on another page of this issue to the new Home Office Order requiring all vehicles in the Metropolis to carry red rear lights after dark. We desire here to urge the necessity, also briefly referred to in the same article, of action to secure that a similar requirement should be extended to the whole of the country. The London Order presumably will only remain in force during the period of reduced street lighting in the Metropolis, but it ought to be made permanent, and it ought to apply to the whole of Great Britain. On dark country roads it is specially necessary. For that purpose legislation will no doubt be necessary, and the two tramway associations should join hands with the powerful automobile interests of the country in urging such legislation. A circular letter of ten years ago, reprinted in the article referred to, shows how great was the need then, and it is much greater now. Tramcars and motor

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cars are much more numerous than they were then, and at that time motor omnibuses practically did not exist. The danger of overtaking collisions between these fast vehicles and slow-moving carts and wagons which carry no rear lights is ever increasing. The fast vehicles, although there is little or not so much chance of their being run into from behind, when in motion, are already obliged to carry rear lights, and there seems to be no reason why carts and drays should not do the same. The agricultural interest may object, but a similar objection was overcome in the case of the existing Act, whereby front lights were made compulsory.

The Charges for Maintenance.

On another page will be found a chart showing the cost of maintenance of the various municipal tramway systems having a combined generating station for traction and lighting purposes. This chart deserves particular attention on account of the great diversity of the amount of this charge in the several undertakings included. Such differences are hard to explain, and the advantage of bringing them together on a chart is that it renders the contrasts conspicuously manifest. At Newport (Monmouth) the cost of maintenance last year was 3·239d. per car-mile, or 1·32d. per unit of electricity consumed, which takes it completely outside the limits covered by the chart. The town has, therefore, been left out altogether, though the charge is in this case due no doubt to exceptional causes, as the figures for the previous year were 1·57 and 1·28 respectively, which would be fairly normal. Perth, on the other hand, is off the chart on the opposite side, the figures being ·39 and 1·09 for the year ended May, 1913, while those for 1914 are not yet to hand. Apart from these extreme cases, however, the differences in the practice of the various managements are too great to be accounted for on any physical basis, as ought to be the case. Any engineer invited to pronounce what factors in working were most calculated to affect the cost of maintenance per car-mile, would indicate the weight and velocity of the cars. Now the weight and velocity of the cars are fairly reflected in the quantity of current consumed per car-mile, a quantity depicted by the dotted lines which traverse the chart diagonally. If the chart be examined it will be seen that on the average the group of tramways expending small amounts on maintenance do consume less power per car-mile than those which spend large amounts, and it is one of the merits of this device of presentation that such a fact is made evident at a glance. As a rough average, an additional consumption of half a unit per car-mile would appear to correlate with doubling the charge for maintenance. This is more than seems at all reasonable, and the great diversity of the positions occupied, transversely to the dotted diagonal line, point to some other more potent and less rational cause for the variations that are found in this item. Some managers are, it is to be inferred, in the habit of adjusting expenditure on maintenance to the exigencies of apparent success in obtaining surplus of earnings, or some like object which has the effect of subordinating physical efficiency to political or financial expediency—always a dangerous course to pursue, and one that frequently defeats its own purpose.

The Tramway Position in Belgium.

The position of tramway companies in Belgium at the present time is inevitably one of the utmost difficulty. Some of them have practically ceased operation, but in Brussels, Antwerp, Ghent, and Bruges cars are run under much reduced timetables and somewhat precarious conditions. From Brussels we hear that only 320 cars are in service, or about three-fourths of the usual number. Repairs and maintenance appear to be kept up only by the expedient of stripping the minor parts of the equipment from the cars not in service. This cannot, of course, be continued indefinitely, and unless the German authorities allow the importation of supplies the service must shortly be abandoned, as general manufacture in Belgium has almost ceased. The stoppage of the service would throw several thousand men out of employment and greatly increase the distress now prevalent; it would add also to the difficulties of the German invaders, who themselves show little disposition to aid the people. The authorities would no doubt prefer that the cars should continue to run as they make extensive use of them. All German soldiers have to be carried free in Brussels, although in Antwerp the

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number is limited, we believe, to six per car. All this aggravates the inconvenience of regular passengers, who have to wait long intervals before they can secure places. The tramway service is all the more useful at present as there is no telephone, no telegraph, and only very irregular postal service. The delivery of letters cannot, in fact, be depended on for the transaction of ordinary business.

BRITISH ELECTRICAL INDUSTRY AND THE WORLD-MARKET.

At a meeting of the Sales Managers' Association, on December 17, Mr. E. H. Scholey, of Messrs. Scholey and Company, electrical and mechanical engineers, delivered an address on the position of the British electrical industry, and methods of extension in the markets of the world. This was full of intensely interesting matter treated from an absolutely independent point of view; it was evident that the speaker was thoroughly conversant with his subject from practical experience and careful study. He emphasised the importance of electrical undertakings by the statement that probably a sum of 500 million sterling was interested in them. Their history was chequered at the beginning; of companies with 23 million pounds formed in 1882 a residue of 6½ million was left in 1896, mainly due to legislation passed for the protection of the public, with the consequence that in 1895 we had in this country 50 miles of tramways as against 12,000 miles in America. To come to more recent times: Mr. Scholey considered that specialisation in manufacture has been remarkably successful in the electrical trades, and, indeed, in many others; but the result is that from a general point of view no work of any great value is being done. On the other hand, the maker of large machines has, as a rule, not paid dividends for years past, through the cutting of prices at home but mostly due to foreign competition and to the fact that we now import into this country more than one-third of the value of the electrical apparatus used by the people. This large importation is also due to the easy terms granted by foreigners, to the conditions laid down by purchasers, conditions they would not impose elsewhere, and to the departure from home standards allowed to tenderers abroad. Again: the foreign manufacturer was content to lose on the machinery if he made money on everything else, and this he could do, as he made everything from a dynamo to a half-inch cock. When, however, the foreigners tried to do this over here, they failed miserably. In neutral markets the Britisher has but little chance against the insidious methods of his foreign rivals, of which Mr. Scholey quoted two notable instances. In our Colonies and Dependencies we hold our ground well as compared with others.

The remedy is combination and co-ordination, not only amongst manufacturers but with their customers, coupled with an enormous enlargement if we are not only to fill the place vacated by the foreigner in our home markets, but also supplant him in other parts of the globe. Patience, reorganisation, and rearrangement will be necessary even to attempt this by co-operating the various sections of the industry, backed by some financial support in the city of London, where they should always bear in mind the importance of the home electrical industry, and that the use of electricity is increasing at an amazing rate.

THE LIGHTING OF VEHICLES.

Question of Rear Lights.

The Secretary of State's order for the Metropolitan Police District and the City of London, which was about to expire at the end of last month unless renewed, has been superseded by a fresh Order. This differs from the previous Order in two particulars only:

1. The use of any lights whatever for outside advertising or for the illumination of shop fronts is now prohibited. Formerly only "powerful" lights were prohibited, and the uncertainty as to what lights were "powerful" led to evasions of the Order.

2. An entirely new provision is inserted requiring all vehicles to carry, in addition to any head lights which the existing law requires, a lamp which shows a red light to the rear. Experience has shown that this is necessary in the present condition of the streets to protect vehicles from being run into from behind.

It should be particularly noted that this requirement extends to cycles and handcarts as well as to other vehicles. The red glass "reflectors" which are so largely used by cyclists are no longer sufficient, but a lighted lamp must be carried which shows red to the rear.

This Order raises afresh the whole question of compulsory rear lights for vehicles all over the country. It may be remembered that in 1904 Mr. Harry England, general manager of the Yorkshire (West Riding) Electric Tramways Company, issued a circular letter to all the tramway and light railway authorities in Great Britain asking them whether they were willing to assist in bringing the question of universal rear lights before the Government. He also had some correspondence with the secretary of the Royal Automobile Club and Motor Union asking these bodies to take action with the Tramways Associations to get a bill passed making it compulsory for all vehicles to carry rear lights. No further action resulted.

The ordinary lighting of provincial main roads is no better and often very much worse than the present subdued lighting in London, and is driven home every day the necessity for red tail lights on vehicles. The present regulation is insufficient and inadequate because the lamps carried on the fronts of vehicles which are supposed to show a red light to the rear are often hidden by merchandise or placed in such a position that the light can only be seen when the vehicle is at a certain angle. The matter is specially important to those who are operating interurban tramways on roads often not lighted at all, and in other cases badly lit. It is also important to all owners of speedy vehicles. The time seems opportune, with the example of London, for doing something.

The following is a copy of Mr. England's circular letter of 10 years ago above referred to. The obvious comment is that the need of the reform is much greater now than it was then:

Rear Lights on Vehicles.

Dear Sir,—We have had several collisions lately entirely due to the fact that ordinary vehicles using the road do not display rear lights.

I know the same trouble is experienced on other tramway and light railway systems, and I feel so strongly that some steps should be taken to bring about an alteration in the present law, so that all vehicles may be compelled to carry rear lights, that I have ventured to write and ask whether you have had any accidents due to this cause, and whether you would be willing to take part in a movement to attempt to bring about an alteration in the law governing this matter.

I believe the various county boroughs and the county authorities have power to make by-laws by which all vehicles within the areas they control would be compelled to display rear lights after sunset, but, as a matter of fact, in the places where such a by-law is most necessary it is not in force.

This question should not be left to the discretion of the local authorities, because by so doing a by-law may be made and enforced by one local authority, whilst in a far more dangerous neighbourhood with badly lighted streets no action will be taken.

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As tramways are now being carried further into the suburbs and along country roads, the need for an enactment by which the men in charge of vehicles may be forced to safeguard themselves and other persons using the roads against accidents, is becoming more seriously felt. It seems absurd that tramcars and motor cars—by far the fastest vehicles on the roads—should be required to display rear lights, and the crawling wagon, with the driver often asleep or tipsy, should be exempt.

Tramcars are so brilliantly lighted that he would indeed be a blind man who ran into one from behind, and motor cars are so fast that it would be impossible for other road vehicles to overtake them. Still both tramcars and motor cars must carry rear lights.

The Board of Trade has very properly given permission for higher speeds to be run on most of the tramways in this country, and although it is possible to safely speed up the cars during daylight, as soon as darkness descends it is courting disaster to run to the same schedule, owing to the fact that a wagon may suddenly loom out of the darkness ahead, and before the motorman has time to stop his car, the collision occurs.

The public cry for quick transit, and unless we, as tramway officials, are prepared to give them what they want, the financial aspect of our undertakings must suffer. The request that all vehicles should be compelled to display rear lights is not an unreasonable one, and I hope I shall succeed in obtaining your support and assistance in this matter.

I am, yours faithfully,

H. ENGLAND,

General Manager.

THE 1,500-VOLT DIRECT-CURRENT ELECTRIFICATION OF THE ONTARIO MUNICIPAL RAILWAY.*

BY G. H. HILL

Various municipalities of the Province of Ontario, Canada, have been considering for some time an extensive system of inter-connecting electric railways. The general scheme provides for a network of inter-urban roads supported, as it were, by a backbone of main line electrification handling a relatively heavy freight service. The links connecting the cities and towns will be municipally owned and operated, thus continuing the already extensive municipal ownership feature existing in Canada.

The scheme, in brief, contemplates new roads, or electrification of existing roads through the central part of that portion of the Province lying between Lake Erie and the Georgian Bay from Sarnia on the west to Toronto and Whitby on the east, passing through London, St. Mary's, and Guelph. This route follows generally the transmission system of the Hydro-Electric Power Commission from Niagara Falls. Several branches and connections are contemplated communicating with all the larger cities in that portion of the Province.

The proximity of the transmission system affords excellent facilities for sub-station locations and precludes the necessity of building a distributing transmission line along a large part of the right-of-way.

The Hydro-Electric Commission of Ontario, Sir Adam Beck, chairman, and Mr. F. A. Gaby, chief engineer, will perform the double function of consulting engineer and contractor for the entire project, installing all equipment ready for operation. The individual sections of the system will then be turned over to the municipalities to operate.

The city of London has taken the initial step, and is now proceeding with the electrification of that portion of the main line between Port Stanley on Lake Erie and London, about 24 miles north thereof.

This road has for several years been leased by the city of London to the Pere Marquette Railroad, and forms an important connecting link between the Lake Erie freight ferries and distributing centres of the Province. The chief commodity for transportation is coal from Pennsylvania.

The single-track line is approximately 23·5 miles long, and passes through Whites, St. Thomas, Glanworth, and Westminster, connecting with the main lines of the Grand Trunk, Michigan Central, and Canadian Pacific Railroads. The profile includes a maximum of 1·0 per cent. grade north of Port Stanley, and contains other grades of 0·8 per cent. and 0·5 per cent. for short distances.

The scheduled service will comprise a locomotive freight traffic and multiple-unit passenger car trains between the two terminals. Sixty-ton locomotives will take loaded freight cars from the ferry boats at Port Stanley and haul them in trains of approximately 800 tons to St. Thomas and London, returning with trains of empty cars. In addition to the above there will be local merchandise freight between the stops along the line. The passenger service will be performed by limited and local trains consisting, a large part of the time, of a motor car and one trail car, providing a half-hourly service in each direction, the limited and local trains alternating.

The Hydro-Electric Commission made a careful investigation of operation when using both high-voltage direct current and single-phase alternating current on the trolley, with the final adoption of 1,500 volts direct current.

The energy will be supplied from two sub-stations, one located at London in an extension of the present Hydro-Electric sub-station, and the other at a distance of 14·2 miles from London, near St. Thomas. The latter will be a new sub-station. Each will be equipped with synchronous converters with their respective transformers and switchboards, converting from 110,000 volts, 25-cycle alternating current to 1,500 volts direct current.

The overhead structure will be of the familiar single catenary type, supported on side brackets from lattice steel poles placed approximately 180 ft. apart on the straight. The 0000 B. & S. copper trolley wire will be supplemented by suitable copper feeders.

The rolling stock covered by the initial order placed with the General Electric Company includes three 1,500-volt 60-ton locomotives, five 4-motor 1,500-volt passenger car equipments complete with multiple-unit control and air brakes, and four trail car control and air brake equipments.

The locomotives are of type 4-0-4, and will be carried on two swivel trucks bringing all the weight on the drivers, the equipment being housed in a steel box type cab extending over practically the entire length of the locomotive. Each will be provided with four GE-251 750/1,500-volt motors designed for 750 volts across each armature, and insulated for 1,500 volts. Two motors will be connected permanently in series, and the two-motor groups thus formed will be capable of connection in series or parallel for speed contol.

The cab will be divided into three compartments, one at each end for accommodating the operator and the intervening compartment where the control equipment and accessories will be located. The operating compartments will be provided with 1,500-volt electric heaters.

Each of the GE-251 motors will have an hourly rating of 245 H.P. with 1,500 volts on the trolley. At this rating the locomotives will exert a tractive effort of 21,500 lb.

Control will be effected by a double-end type M standard equipment, a master controller at each operating position actuating the main 1,500-volt contactors by means of a 600-volt circuit supplied from a dynamotor.

*Mr. G. H. Hill is an assistant engineer in the Railway and Traction Engineering Department of the General Electric Company, New York, from whose review this article is reprinted

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Multiple-unit train operation is arranged so that the simultaneous control of three locomotives coupled together can be accomplished from any master controller. The equipment is also so designed that a locomotive may haul a train of eight or 10 passenger trail cars and provide lighting energy for them.

The current collectors will consist of pantagraph slider trolleys having two contact pans pressing against the trolley conductor. Two of these devices will be furnished on each locomotive. They will be electro-pneumatically controlled from any operating position with one, two or three locomotives hauling a train.

Each motor passenger car will be driven by four GE-225 750/1,500-volt fully ventilated commutating-pole motors connected two groups of two in series. The one-hour rating is 125 H.P. with 1,500 volts on the trolley.

Each motor car has sufficient capacity to haul one trail car, and provision is made for the motor and trail cars to be operated in trains up to a total of three motor and three trail cars. All trail cars will be equipped with master controllers at each end, so that multiple-unit train operation is possible from either end of any motor or trail car.

Control energy for a motor and trailer will be derived from a 1,500/600-volt dynamotor on each motor car. The dynamotor will also supply energy for lighting one motor and one trail car. Main and auxiliary train cables will run continuously throughout a train, provision being made for the simultaneous raising and lowering of all pantagraphs and also for simultaneous sanding (by electro-pneumatic valves) of all cars from any operating position. The pantagraph trolleys will be identical with those on the locomotives.

Each car will carry a combined straight and automatic air-brake outfit of the variable release type, with the air supply furnished by 1,500-volt compressors. The compressor governors will all be equalised on a special wire running throughout the trains in the auxiliary train cable.

The cars which will be placed in service on the London and Port Stanley Railway will be built to the Commission's specification. They will be all steel, 59 ft. long and thoroughly modern in every respect. The motor and trail coaches will be identical except for motors. The former will weigh approximately 51 tons loaded and equipped, while the latter will have an approximate loaded weight of 32 tons.

The growth of the Ontario Municipal system will be watched with much interest, since it marks a rather novel departure on a large scale from the usual American procedure.

FREE PASSES FOR EMPLOYEES.

Mr. T. B. Goodyer, general manager of Croydon Corporation Tramways, has sent to us the following summary of information he has obtained from 92 tramway undertakings respecting free passes issued to employees for use when off duty:

Systems allowing employees to travel free—to and from duty only	*79
Systems allowing employees to travel free to and from duty, and with restrictions, when off duty	†5
Systems allowing employees to travel free at all times	‡7
Systems not allowing free travelling at all	1
Systems not allowing free travelling off duty	80
Systems having received a request for free travelling facilities—on and off duty	11
Systems not having received such a request	81

* In the great majority of cases this refers to uniform employees only.
† Including one Metropolitan company system.
‡ Including two Metropolitan company systems.

A request was recently made by the Croydon tramwaymen that "free passes should be issued to all employees." The Tramways Committee, after considering the general manager's report upon the matter, resolved that the application be not acceded to.

PUBLICATIONS.

Electrical Engineering in India.

By J. W. Meares, F.R.A.S., 1914. 517 and xxxvi. and 21 pp. of advertisements. 8¼ by 5⅝ by 1¼ in. Bound, 15s. net. (Thacker, Spink, and Company, Calcutta; and Thacker and Company, 2, Creed Lane, E.C.)

Mr. Meares is a member of the Civil and Electrical Engineers' Institutions, is Electric Adviser to the Government of India and Officiating Controller of Patents and Designs. He has been mainly responsible for the Indian Electricity Rules, of which 36 are scattered throughout the book, as are the Wiring Rules of the Institution of Electrical Engineers; they are summarised with their subject-matter under these headings in the index. This is very full and covers 33 pages. In an appendix is given the Institution of Electrical Engineers' Model Form of Conditions and Specfications, as revised in April, 1914. The author gives a preface and an introduction, which we would recommend as unassuming examples of Mr. Meares' claims to be an eminently practical and experienced authority. The work, while specially designed for students and men in India whose technical knowledge has become rusty in parts, will be found most useful to all electricians. It is well printed on opaque, thin and smooth, but not shiny paper, with three plates and 75 excellent illustrations. It is divided into three parts, and 24 chapters. Part I., says the author, may be skipped by students and reviewers, and the latter part of Chapter III. by "engineers who may only be concerned with practical applications of electricity." Examples of these have been freely used, in fact, the whole work is an eminently useful exposition of the theory and practice of electrical appliances and installations. Part I. (with four chapters) is elementary; Part II. (with six chapters) is concerned with domestic electrical installations; and Part III. (with 12 chapters) is on electric plant and work. The whole production is a credit to the publishers and printers, and to Mr. Meares and those whose assistance he recognises.

Tractive Resistance of a 28-Ton Electric Car.

By Harold H. Dunn. Bulletin No. 74, Engineering Experimental Station, University of Illinois. London: Chapman and Hall. 1914.

This bulletin records the results of tests made with a 28-ton electric car of the double-end type for the purpose of determining the resistance offered to its motion when running on straight level track in still air at uniform speed, and to ascertain the relation existing between that resistance and the speed of the car. The tests were made on sections of straight track representative of good electric railway construction, during generally fair weather when the average temperature was not below 25 deg. F., and when the wind velocity did not exceed 26 miles per hour. The plan of the tests, which involved running the car backward and forward over a selected section of track, made it possible to eliminate wind resistance.

The results are finally expressed in the form of a curve whose co-ordinates are car resistance and speed. This curve shows that at 5 miles per hour the car resistance was 5·25 pounds per ton, that at 25 miles per hour it was 13·03 pounds per ton, and that at 45 miles per hour it was 26·12 pounds per ton. The average results from the individual tests did not vary more than 9 per cent. from this final curve.

Brill Magazine, for November, 1914 (the J. G. Brill Company, Philadelphia, and 110, Cannon Street, London, E.C.), has been issued since 1906, and it has gradually grown in interest with the steady expansion of the company. The number under review gives most excellent illustrations of many types of cars recently built by the company for various traction companies. The designs are in many respects strange to this country, but are nevertheless well worthy of close study. They all appear to be non-reversible—a decided advantage where loops or reversing triangles can be provided—and many of them have centre entrances with low footboards, and are fitted for the pay-as-you-enter system. Centre-entrance cars are apparently growing in favour in the States. Amongst recent orders completed are six cars of this type for the New Jersey Central Traction Company; and the illustrations show a novel arrangement of the interior. These cars are single-deck bogie cars, and weigh without electrical equipment 18,340 lb. The electrical equipment adds 1,600 lb.; air brake equipment, 1,900 lb.; trucks and gears, 16,280 lb.; and the four motors 11,400 lb.; giving a total weight of 49,520 lb. A special feature in the number for November is the "Safety Campaign"; this is devoted to the interests of children, and is addressed to them and to those responsible for their limbs and lives.

CATALOGUES.

The Commercial Cars Limited, Briscot Road, Luton, have just issued their 1915 catalogue, which provides what may fairly be termed a Barmecide feast. It contains many illustrations, both plain and coloured in its 39 pages (11¼ by 8½ ins.), of Commer petrol-driven cars for goods and passengers. The frontispiece shows one day's delivery to the War Department of 13 of their lorries; in fact, although their factory at Luton has been doubled during the last 18 months and is

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being further enlarged, they can keep pace with only one of their customers' demands. A list of these covers six pages of their catalogue, all of which have to wait on the needs of the one customer—the War Department. This omnivorous body has impressed the majority of the cars in the hands of firms throughout the country, most of whom are clamouring for vehicles to replace those that have joined the colours. Commer cars have now been on the market for seven years, but in the last few of these it has not been found necessary to make any appreciable difference in the firm's models. Every possible information is given regarding the various designs, including not only the original price but the running costs of seven different types at mileages of from 250 to 450 miles a week.

The Edison and Swan United Electric Light Company, Limited, Ponders End, Middlesex, 123-125, Queen Victoria Street, E.C., and 71, Victoria Street, S.W., have published a new catalogue (Section viii., Part 3), dealing with "Ediswan" heaters and radiators. This embodies a number of novelties; the prices have been revised in consequence of the present cost of raw materials. Sixty different models of these heaters are illustrated and priced, covering a great range of designs adapted to all conditions and to every taste.

Messrs. Robert Kearsley and Company, Limited, Ripon, Yorkshire, and 129, Curtain Road, E.C.—This firm has issued a booklet giving the names and prices of 151 different coach and motor colours, and samples of 50. These latter hardly do justice to the originals. The firm has been established more than 75 years; its works cover five acres, and the machines are electrically driven. At foreign and Colonial agencies large stocks are kept of their colours and varnishes, and of sundries appertaining to the industry.

Messrs. Youngs, manufacturers of lifting appliances, Ryland Street Works, Birmingham, have issued a list of their "Ryland" patent worm-screw pulley-block, which is now made to lift up to three tons; these blocks are quick lowering and are quite under brake control; this comes into action and stops the action of the pulley directly the hand chain is let go. The brake action is directly proportionate to the load and can be released for quick lowering by pulling the brake cord; thereby the speed of lowering is entirely under the control of the operator. The price varies (with chain for a 10 ft. lift) from £5 10s. to lift 10 cwt. up to £12 10s. for a 3-ton load. If designed for traversing on the bottom flange of overhead girders, the prices are from £9 15s. for a 5-cwt. load to £20 10s. for a 3-ton load. Messrs. Youngs also manufacture other hoisting appliances.

Catalogue P. 502, issued by E. Green and Sons, Limited, Wakefield, is a handsome large octavo volume, in limp covers, of 155 pages, with numerous illustrations (some of them in colours) and 10 folding plates. In these the history is given very fully of the patent fuel economisers for steam boilers, first invented by the late Mr. Edward Green, in 1845, and its subsequent improvement and development. The works cover 20 acres, and 1,000 men are employed; the plant has been reconstructed throughout, and some years ago branch works were established at Matteawan, U.S.A. There are also branches at Hastings House, Norfolk Street, W.C., in other parts of the United Kingdom, at Cologne, and at Lille. The firm will employ their own men in any place at home and on the Continent. The apparatus saves a great deal of fuel wherever it is employed, whether under high or low pressure, in blast furnaces, refuse destructors, or in heating buildings. The firm also manufactures pumps and small engines when required in connection with their economisers.

The Coventry Roller Chains.—In a pamphlet of 36 pages (D/5) 8vo., the Coventry Chain Company, Limited, fully describe and illustrate these chains. Their head office and works are at Spon End, Coventry; their other addresses are 47, Victoria Street, S.W., and 233, Deansgate, Manchester. The standard single-roller chains are made with breaking loads of from 2,200 lb. to 90,000 lb., and have been applied for years past for automobile and general power transmission, many applications of which are included in the pamphlet. Tables which have been found useful and accurate are those of pitch-line diameters from ½ in. to 3 in. pitch, and with from 8 to 100 teeth. A similar table (which is incorrectly marked "in inches") also gives the same information in millimetres from 30 to 45 millimetres pitch.

Messrs. John M. Henderson and V. King's Engineering Works, Aberdeen, have designed and carried out aërial ropeways for many years past, and for all kinds of purposes, both in England and abroad. Where used for short distances these ropeways are very simple, most effective, and reliable. For instance, at Knowesgate, Northumberland, a line 400 feet long, put up for the County Council, is worked by a single endless rope with two skips, which arrive at the terminals simultaneously; 150 tons a day are transported and lifted 50 ft. from a quarry to a tar macadam plant, with an expenditure of 8 B.H.P. This installation and many others is described in Catalogue 510. In addition to being contractors for aërial ropeways, Messrs. John M. Henderson design and manufacture machinery of all kinds for handling materials under any conditions; also plant for the economical transportation of materials in and about factories, mills, wharves, warehouses, mines, quarries, estates, engineertng, and other undertakings, public works, etc.

The Churchill Grinding Machines, by Charles Churchill and Company, Limited, 9—15, Leonard Street, E.C., 115 pages cloth, 11 by 8½ by ¾ ins. Printed by Blades, East, and Blades on thick glazed paper—a most artistic production. In this book are shown the characteristics of designs peculiar to the firm, as used in every branch of engineering industry and as made in their works at Pendleton, Manchester. Photographs of the various machines are reproduced on nearly every page, and full particulars are given of the horse-power required for them, and all other information useful to buyers. Finally there is a list of code words and an index.

"The Leading Light" is the title of a striking circular published by the General Electric Company, Limited, 67, Queen Victoria Street, E.C. The frontispiece of the folder is in colours and depicts the leading ship of a squadron ploughing the waters with an enormous Osram lamp as a headlight. The contents are described in an inset. Eight different forms of Osram drawn-wire lamps and one half-watt patent lamp are illustrated and priced. They are all of British make entirely; the tungsten wire forming the filaments is drawn at the Hammersmith works and the glass bulbs, etc., at Lemington-on-Tyne; the parts are assembled at the former place. While arc-lamp carbons are difficult to get, these lamps come as an efficient and economical substitute for them.

CALENDARS.

The General Electric Company, Limited, have favoured us with a large folding blotting pad in a handsome leather cover, provided with pockets of sizes. Various information regarding the firm's products is scattered over the inside of the cover and on the sheets of the pad.

The British Thomson-Houston Company have issued for 1915 a striking and artistic calendar printed in two shades of brown, a unique feature of which is that each sheet contains three months, *i.e.*, the present, past, and future. A picture of the works at Rugby and photographs of the various machines supplied by the B.T-H. are given in the centre of each page.

Henley's Cables wall calendar for this year measures 15 by 11 in. It is dated 1837-1915. There is a weekly tear-off leaf attached, on each of which some speciality is noted of Messrs. W. T. Henley's make. A good view of the Tower of London is reproduced on the face, and the whole production is artistic and pleasing. The firm's head offices are at Blomfield Street, London Wall, E.C., and their works at North Woolwich and Gravesend.

The presentation wall calendar of Alfred Herbert, Limited, Coventry, consists of 12 tear-off sheets 15 in. by 9½ in. each, containing photographs of the works, or parts thereof, and of the firm's numerous specialities. The January sheet, for instance, shows a fleet of over a dozen carts laden with capstan lathes for Petrograd. In the right hand bottom corner are sepia vignettes of machinery parts; one of them depicts an 18,000th screw emerging from a patent self-opening die-thread, the dies of which had not been reground.

The wall calendar published by the "Underground" at Electric Railway House, Broadway, Westminster, consists of 12 sheets measuring 20 by 12 in. Each of these sheets illustrates the natural history of London, and indicates by what route you can get to see them. Life-like pictures by Edwin Noble are reproduced in colours by Messrs. Johnson, Riddle, and Company, London, S.E., and are well worth preserving as works of art. They represent seagulls on the Thames; pigeons in the city; herons at Richmond Park; sheep at market; rabbits of the outer ring; swans on the Thames; water-rats at home in brooks on the outskirts; peacocks at Kew; deer in the parks; pheasants in the woods; squirrels and rooks.

Messrs. Brecknell, Munro, and Rogers, Limited, Thrissell Street, Bristol, manufacturing and electrical engineers, have issued a presentation wall calendar. A set of small "tear-off" leaves is mounted on stout cardboard 19½ in. by 8¾ in., on which is fixed a coloured view of London, by H. E. Tidmarsh, beautifully reproduced by Messrs. E. S. and A. Robinson, Limited, Bristol. This view measures 16 in. by 4 in. and is a panorama, evidently taken from the top and centre of the Tower Bridge, extending from, or including, the Tower of London to beyond the Houses of Parliament. From the clearness and sharpness of the details it would appear that the picture is based on an excellent photograph. The atmospheric effects give the true perspective, and the whole production is reminiscent of the Ackermann coloured prints of many years ago without their crudeness.

Reduction in Coal Prices.—Expectation has been justified by the settlement, at a comparatively early date, of the railway companies' contracts for steam coal. The general state of trade indicated that some concession would have to be made by the coalowners, and a reduction of 6d. per ton has been accepted, making the new contracts at the rate of 11s. per ton for the best hards over the next year. For comparison, it may be mentioned that the price paid by the railway companies in 1911 was 8s. 9d. per ton, 1912 10s. per ton, and 1913 11s. 6d. per ton.—*Yorkshire Post.*

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BOMBARDMENT OF THE HARTLEPOOL TRAMWAYS.

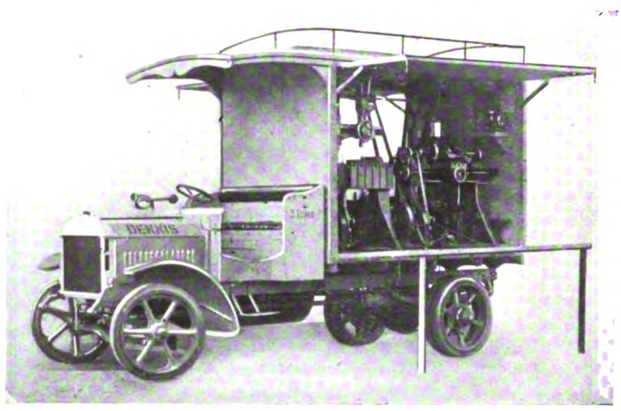
During the bombardment of Hartlepool on December 16 by German war vessels, the municipal tramways suffered considerable damage. Mr. Charles Burgess, general manager and engineer, writes that the roof of the offices was struck by shells, and a part of it was carried away, the remaining portions of the offices being slightly damaged. The flagstaff on top of the depot was splintered, and a shell fell a few yards to the rear of the depot and buried itself in the railway embankment. On two points on the Hartlepool route and one on the Park

Effect of German Shells on the Hartlepool Corporation Tramway Offices.

route the trolley wires were brought down. The total length approximated 300 yards, but no poles were damaged. Windows of several of the cars in service were shattered, and a controller on one car standing in the depot was struck by a piece of shell which came through the window of the depot. One member of the office staff sustained a slight scalp wound, but fortunately no other members were injured, although the depot staff were on duty when the firing commenced. This lasted from 8-5 to 8-45 a.m., and about an hour after the bombardment ceased the service was resumed on three routes, and on the remaining route about 5 p.m., when the repairs to the overhead lines were completed. Considerable extensions to the depot, which have been in progress for some time, and are now approaching completion, fortunately escaped any damage.

A WORKSHOP MOTOR CAR.

We illustrate below one of four Dennis workshop cars which are now being used for military work, we believe in connection with aircraft repair. The power to drive the machine tools is obtained from a 4-H.P. single-cylinder petrol motor, which also runs a dynamo for lighting the workshop, and for running a dozen hand lamps provided with long flexes so as to allow them to be placed in any convenient position. The advantage of making the car self-contained, and not using the car engine to run the tools, is that in the event of a long job the body can be taken off the chassis and used as a stationary workshop, while the chassis is employed for other purposes.



A Dennis Workshop Motor Car.

The cars are very completely equipped, and contain amongst other things the following tools: A 6-in. lathe fitted with treadle motion and counter shaft, a portable forge complete with 20-in. bellows, an anvil mounted on block, a vice stand with drawer and vice, an electrical drill with three speeds, a radial drill fitted for treadle and power drive, an electric tool grinder. In addition, the cars are very completely fitted up with hand tools of all sorts.

Group of Leeds Corporation Tramway Traffic Staff in 7th Battalion Leeds Rifles.

THE LEEDS TRAMWAY STAFF.

The photograph reproduced above presents a group of the traffic staff of the Leeds Corporation Tramways, most of whom are in the Seventh Battalion Leeds Rifles. Two sons of Mr. J. B. Hamilton, general manager of the Leeds Corporation Tramways, viz., Mr. J. S. and Mr. T. Hamilton, have received commissions in this battalion.

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CORRESPONDENCE.

Brake Equipment.

To the Editor of the Tramway and Railway World.

Sir,—We note that in your issue of December 12 you draw attention to the fact that there is a necessity for further attention to the question of brakes, the majority of accidents still being attributed to locking the wheels.

Considering the number of approved emergency braking devices at hand, not necessarily acting on the wheels but on the track, that can be applied either by compressed air, vacuum, hydraulic, oil, and magnetic pressure, the responsibility for runaway cars to-day lies with the municipal and company authorities themselves in failing to encourage their management in their desire to run the tramways for public welfare and safety, on business lines.

The authorities, as a general rule, give their decision regarding improvements from a financial point of view, and it is just here that the question of even the hand brake equipment has been misunderstood, by purchasing the cheapest materials for brake blocks containing, as a rule, a large percentage of grit and sand in a soft iron casting.

The brake block here described gives a high coefficient of friction owing to the presence of excessive molecules of iron between the wheel and brake block, which naturally wear both rapidly.

This high coefficient brake block was justifiable to a certain extent when, in the early days, brake rigging was coupled direct to the hand brake staff. Here, in applying the brakes, the driver exercised his sense of feeling, the actual retardation of the blocks and the amount of work done being recorded at his wrist, and he felt the effect of every extra pound of pressure he exerted on the brake handle up to and including feeling the actual skidding effect immediately it took place.

This, so far, served a purpose until the weight of the car and its speed were increased to such an extent that it became necessary to have a more accurate and powerful brake and one that would act independently of even the human element, practically taking the control out of the driver's hands entirely, or what is known as an ideal brake. This in reality has been attained successfully by managers and manufacturers alike, and adopted by some of the principal tramways which have the public interest at heart. However, there still remain a large majority who have not risen to the occasion, and have only adopted some means to increase the leverage, or gear up the hand brake staff, which, with the soft-iron brake blocks already referred to, makes a very unsatisfactory combination to place in skilled or unskilled drivers' hands.

No matter how skilful the driver, the combination referred to spells disaster sooner or later, as you are then relying upon the mental judgment and experience of the driver as to whether the brake application is effective or not. On the driver realising that his application has not been effective, it naturally occurs to him to apply more pressure, resulting in the wheels being picked up without his actual knowledge, the result of which is only noticed when too late to be overcome.

This does not necessarily condemn geared brakes, but every one must be accompanied by a correspondingly hard and tough brake block giving a standard and even coefficient of friction. This combination is less susceptible under increased pressure to skid the wheels, there being less grit or molecules of metal between the wheel and brake block, hence less wear on both. In fact, with a well thought out combination of this kind scientifically applied it is well nigh impossible to pick up the wheels.

Where gradients are encountered, however, an ideal slipper brake worked mechanically or by other means is essential.

Looking back at the three recent accidents referred to in your column and analysing the result, one would expect to find the primary cause was excessive braking power and high coefficient material being placed at the driver's disposal, which in turn renders the electric brake ineffective. The actual application of the slipper brake is invariably left till the last minute and too late to avoid the consequences.

Assuming the slipper brake is applied at a high rate of speed, excessive heat is immediately generated between the two metals, which soon reduces the cast iron coefficient of friction to a minimum; the molecules of metal on the braking slipper also become glazed similarly to the rail and rendered ineffective.

Hence, you must either give the driver full control with reasonable safeguards against his judgment or take the control practically out of his hand, and render the application positive in action, as year by year has proved essential and will in the future if accidents are to be avoided.

Yours faithfully,
J. A. Panton.

7 and 9, James Street, Liverpool,
December 30, 1914.

"Transit facilities are as necessary to the vigorous growth of a city as good blood is to the human body, or plentiful money is to trade. In each case it is a circulatory system on which healthy life, growth, and development depends."—*Brill Magazine.*

ITALIAN TRAMWAY CONCESSIONS.

Concessions for the Polesine Tramways.

Particulars were given in the Italian State Railway Review of August 15, 1914, of the important tramway proposals projected by the Provincial Administration of Rovigo to meet the demands of the heavy traffic which had arisen in the upper and lower districts of Polesine, as a consequence of the improvements which have been carried out, and also in order to connect the numerous provincial centres with the existing railway lines. Details were also given of the Badia-Ficarolo-Occhiobello-S. Maria Maddalena line with the branch line Sariano-Ostiglia, for which the concession was at that time demanded.

The usual preliminary investigations have now been made, and the concession for these lines has been granted to the "Company for the Construction and Operation of the Steam Tramways of Polesine," and approved by Royal Decree. Powers have now been asked for the concession for a second group of lines, viz., Trecenta-Fratta-Rovigo; San Bellino-Lendinara; Occhiobello-Fratta and Rovigo-S. Martino di Venezze. This proposal has been examined by the Committee of Public Works, and this body has decided that the concession can only be given for the lines Trecenta-Fratta-Rovigo and Occhiobello-Fratta, with connections to the State Railways at the Rovigo and Fratta stations, and further that, as in the case of the lines forming the first group, the concession can be granted for an annual subsidy of 1,500 lire for a period of 50 years.

The two lines approved have a total length of 47·200 kilometres, *i.e.*, 33·800 kilometres on the first and 13·400 kilometres on the second. The first line will run over 1·695 kilometres of the provincial roads, 23·600 kilometres of the communal roads, and for a distance of 8·505 kilometres over its own ground; the second will run 10·400 kilometres over the communal roads and three kilometres over its own ground. The ruling gradient of both the lines is about 25 per 1,000; the minimum radius of curve is 120 metres. They are standard gauge, and the permanent way will be formed of rails weighing 27·600 kilograms to the metre, and 12 metres in length.

The chief works involved in the construction *de novo* of the two tramways in question are: For the first line a bridge with metal girders and a span of 7·95 metres, over the Scotico Canal; two bridges in reinforced concrete over the Valdentro sewer, one of which is to have a span of 9·15 metres and the other of 8·40 metres; two over-line bridges in reinforced concrete over the Bologna-Venezia and Rovigo-Chiogga Railways. For the Occhiobello-Fratta service a bridge over the Padano collecting line is projected with a span of 10·80 metres, and another bridge, also in reinforced concrete, over the Bianco Canal, with five openings, of which the central span is 15 metres, the two adjacent spans 13 metres, and the end spans 6·80 and 5·40 metres respectively. The stations which it is proposed to build on the two lines are as follows: On the Trecenta-Rovigo Line, Trecenta, Canda, Castelguglielmo, S. Bellino, Fratta Polesine, Villamarzana, Grignano, and Rovigo. On the Occhiobello-Fratta Line, Occhiobello, Fiesso, Pincara, and Fratta Polesine.

The cost of construction for the two lines is estimated at 2,320,000 lire approximately.

New Electric Tramway in Parma.

With the object of bringing directly to the Garibaldi Gate station the steam tramways of the Province of Parma operated by the National Railway and Tramway Company, the goods conveyed by the tramways of Val Baganza (Parma Fornovo) and of Val di Ceno (Parma-Marzolara), which lines at present terminate at the Nino Bixio Gate, and for which the Provincial Administration of Parma holds the concession, and also for the purpose of completing the circular line around the city, the Administration has applied for and obtained the concession to construct and operate by electric traction a new section of standard gauge, which starting from the Nino Bixio Gate and following the encircling route on the west of the town, will extend to the Garibaldi Gate.

The projected section, 2,783 metres in length, will be operated by the same system as the internal network of Parma, *i.e.*, monophase with a potential of 400 volts. The permanent way will be formed by rails of three different kinds: Vignoles rails of 21 kilograms to the metre for the section between the Nino Bixio and Azeglio Gates; Vignoles rails of 27·600 kilograms to the metre from the Azeglio Gate to the Bottego Bridge; and Phœnix rails of 42 kilograms from the Bottego Bridge to the Garibaldi Gate. The estimate of the cost of the laying down of this tramway is 111,000 lire.

A Short Extension at Turin.

The Administration of the Municipal Tramways of Turin has been authorised to extend the urban tramway between the Piazza Castello and the Monumento di Crimea up to the Val Salice Gate. This extension will have a total length of 180 metres, will start from the present terminus at the Piazzale del Monumento di Crimea with a double line, and will run through the Via Val Salice with a single line as far as the Val Salice Gate, where the new terminus, formed by a simple doubling of the line, will be situated. The methods of construction and operation of the new section will be identical in every way with those of the other municipal tramways of Turin.

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SERIOUS STOPPAGE OF LONDON TRAMWAYS.

ACCIDENT AT GREENWICH POWER-STATION.

On Friday evening, December 11, the whole tramway system of the London County Council, with the exception of a short section in the East End, which is separately supplied with energy, came to a standstill. The stoppage occurred just after five o'clock, so that the inconvenience was very great. The traffic was not resumed till Saturday, and then only to a very limited extent. On Sunday, when the service is always a limited one, the number of cars available was about the average. On Monday something like a normal service had been restored, and as the week went on it was gradually again brought up to its full pitch. The fact that the County Council run in the ordinary way some 1,500 cars, mostly of the large eight-wheeled type, indicates the amount of inconvenience arising from the stoppage. This was the most prolonged breakdown which has occurred since the County Council adopted electric traction.

Practically the whole of the lines worked by the County Council, which aggregate 141·21 miles of route, are fed from the Greenwich generating station, and the system employed is the usual high-tension three-phase method, with sub-stations scattered over the area supplied.

The following official statement of the circumstances has been sent to us by Mr. Fell, chief officer of the tramways:

The high-tension switch gear at the London County Council's generating station, Greenwich, is undergoing reconstruction necessitated by the provision of larger turbine units in substitution of the old reciprocating engine units, and the work would have been practically finished by the end of the month. In connection with the fixing of larger cables, a wooden staging had been erected underneath the high-tension switch gallery.

At 5 p.m. on the evening of December 11, under normal load, a case containing oil-immersed instrument transformers exploded with great violence, scattering the burning oil in all directions, and igniting the temporary wooden staging. Almost instantly the whole was ablaze, burning out the generator cables connecting the various portions of the high-tension apparatus, and shorting all the generators on load.

Three of the turbine generators running were protected by reactances and suffered no damage; two of the reciprocating engine generators had no reactances fitted, as they will shortly be removed, and as a consequence of the short circuits several stator coils were damaged.

A complete shut-down resulted, and as soon as the plant was cool enough to handle, steps were taken to ascertain the damage and effect repairs. One unit was connected up and running in 12 hours, and a second unit in 26 hours; the remaining units were replaced one each day, and the whole of them were at work within a week of the shut-down, with permanent cable connections, and the two engine generators were also repaired.

The instrument transformers were constructed in 1905, and were rebuilt for a larger capacity five years later. They have been in constant work since 1910, and are of a similar type to others in the station, which, though they have been at work for some 10 years, have given no trouble. Had the accident not occurred, the transformers which failed would have been replaced by more modern ones within a few days, and the staging would have been removed.

Whilst the repairs were proceeding, a restricted car service was run by energy obtained from the London Electric Supply Corporation, the North Metropolitan Tramways, the County of London Electric Supply Company, the London United Tramways Company, the Leyton Urban District Council, and the West Ham Borough Council. A special cable was connected from the generating station of the St. Pancras Borough Council to the local tramway sub-station, and a supply was given on the evening of December 12.

A supplementary statement was presented by the Highways Committee to a meeting of the County Council on December 22. It contained the following additional information:

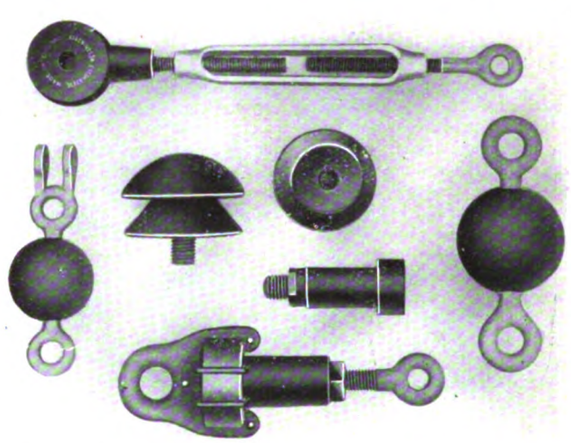
The transformer case which exploded was supplied in 1905, and was rebuilt in 1910 to suit the turbo-generators. It was examined in the early part of last month, and a sample of the oil was electrically tested with satisfactory results at the beginning of the present month. There are in the station more than 40 sets of similar transformers, none of which has given any trouble. The accident was not due to any defect in the plant, and had it not been for the presence of a large quantity of wooden staging, which caught fire, the damage would have been quite localised and would not have interfered with the working of the service

In the opinion of the Highways Committee, very great credit is due to the staff for the expedition and skill with which they dealt with the situation and for the zeal which all have shown. They also think it right to place on record their appreciation of the ready manner in which assistance was afforded by those authorities and companies who were in a position to help the Council. Fortunately an accident in similar unfavourable circumstances is not likely to recur. In the case of so large an undertaking as the Council's tramways it is not possible to arrange for an alternative source of supply which could be adequate in all emergencies. Certain arrangements have already been made for linking up the system with other sources of electrical supply, but in order to minimise the inconvenience arising from any other accident for which it is reasonable to make provision, the Highways Committee are considering how these arrangements may be improved and extended, and they hope to submit a scheme for the Council's approval at an early date.

It may be noted that instead of showing the usual increase the traffic receipts of the tramways for the week in which the accident occurred showed a falling off of £6,391 compared with the corresponding week of the previous year.

OVERHEAD FITTINGS FOR ELECTRIC RAILWAYS AND TRAMWAYS.

R. W. Blackwell and Company, Limited, inform us that the stoppage of import of German materials has largely increased their business in the supply department. This is specially noticeable in all kinds of insulating material and fittings. For many years Messrs. Blackwell have specialised in railway, tramway, and power transmission line fittings, and at the present time hold large stocks including high-tension insulators both of the pin and the suspension type. They also hold large stocks, ready for immediate delivery, of insulating cloths and tapes of all kinds. Some of these are made in their own works, and experience has proved them to be good examples of really efficient pitch and bitumen insulating material. Messrs. Blackwell have recently introduced a new line of insulated fittings for overhead tramways; these comprise Brooklyn strains, globe strains, insulated bolts, etc., all of which are of British manufacture. The insulating composition is of a reddish brown



colour, non-absorbent, tough, and thoroughly homogeneous, and is moulded while hot under pressure up to 75 tons to the square inch. It is claimed that this process ensures greater durability and permanent insulation than has hitherto been found possible.

Tests made by the National Testing Laboratory on standard tramway bolts show that after 48 hours' immersion in strong brine they successfully withstood a pressure of up to 32,000 volts without puncture. It was found impossible to exceed this voltage owing to flashing over.

In view of the fact that such a large proportion of the tramway insulators in use at the present day are of American or Continental manufacture, it is interesting to note that Messrs. Blackwell's insulation is wholly of English manufacture, and with their long and varied experience in handling this class of material, this should prove of value to all interested in electric traction or transmission. The iron parts are of galvanised malleable to Admiralty tests and specification, while the gun-metal fittings are of a special mixture particularly suitable for the purpose and having a breaking strain of 14-15 tons per square inch.

Messrs. Blackwell and Company are, it may be added, always ready to design and manufacture special lines or individual fittings to suit the requirements of special circumstances, both in regard to insulation and current collection.

Tramways and Light Railways Association.—It is announced in the "Tramways and Light Railways Association Journal" for December that the annual dinner of the Association will be held as usual either in February or early in March next. The date will be determined later. The journal for December also contains a complete list of members of the Association and a list of applications made for Light Railway Orders in November. None of the applications provide for the construction of new lines, the proposals being limited to extension of time and transfer of powers.

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FINANCIAL REPORTS AND MEETINGS.

PROVINCIAL TRAMWAYS COMPANY.

EFFECT OF THE WAR ON TRAFFIC RECEIPTS.

Mr. Andrew Beattie, D.L., J.P., presided at the 57th ordinary general meeting of the Provincial Tramways Company, Limited, held on November 27, at the offices, Moorgate Station Chambers, London, E.C.

The chairman paid a tribute to the memory of Mr. John Glenn, C.E., one of the directors who had died since their last meeting. He had been connected with the company since its formation, and was a man of great ability and energy, and the directors felt that they had lost a good friend and valuable colleague. The chairman went on to deal with the report and statement of accounts for the year ended September 30 last. The profits were £40,297 10s. 11d., which were a little less than a year ago, but which, under the circumstances, might be considered satisfactory. Up to August last the receipts were some £4,534 in excess of 1913, but the result of the war was an enormous decrease in the daily receipts. "Don't find fault with the directors," the chairman continued, "but place the blame on the real culprit, the Kaiser, so that in place of having an increase of £6,000 or £7,000, as we would have if the war had not taken place, our increase was reduced to £1,623. This we look upon with complacency." The decrease in net revenue was, he said, £542 8s. 4d., and as to the distribution of the profits, he regretted that they did not see their way to pay 8½ per cent., as last year. They believed it would be more prudent to reduce the dividend to 7½ per cent. and increase the carry over. The entire rolling stock, permanent way, and other property was well maintained, and had it not been for the terrible war the year would have been by far the best in the history of the company. As to the future, no one could tell what would happen. The money spent by reason of the war would be gladly paid by the nation generally, and they would do their part gladly, but the thousands of men who lie in foreign graves were the greatest loss, and should impress them more deeply than any small temporary loss to which they might be subjected. As to the present year, he was glad to tell the shareholders that since October 1 they were roughly £2,000 better off in receipts than for the corresponding period last year. He moved the adoption of the report and statement of accounts, which was seconded by Mr. Samuel Hern, and adopted without discussion. Votes of thanks were passed to the chairman and directors, and to the management and staff in London and the provinces.

ISLE OF THANET ELECTRIC TRAMWAYS AND LIGHTING COMPANY, LIMITED.

The ordinary general meeting of this company was held on Thursday, December 17, at Winchester House, Old Broad Street, E.C., Mr. A. R. Monks (chairman of the company) presiding. The secretary (Mr. J. Barber Glenn) having read the notice convening the meeting and the auditors' report,

The chairman then said that the debenture loan had increased by £100,000 mainly to cover electrical installations, new plant, motor omnibuses, electrical stores, etc. Out of revenue account money had been expended in respect of repairs to permanent way on the front and at Madeira Road and Canterbury Road, as also in relaying some rails and in repairing rolling stock. During the year £11,725 was expended on new electrical installations to meet the growing demands for lighting and power, which were effecting a considerable saving in coal consumption. The company had 195 extra consumers, although the company would not feel the benefit during the present year. The item of £815 was for motor omnibuses which had been delivered and upon which the company was making a reasonable amount of profit, but in August the chassis had been commandeered by the Government, and they were left with the bodies; these they were now replacing. Regarding the item for new plant, £11,725, he had said at the meeting last year that they were making arrangements for the instalment of a Curtis turbine. This had now been carried out, and the machine had worked most satisfactorily and economically. With the completion of this turbine there would be no expenditure for new plant, beyond a few hundreds or so, for many years. The increase in expenditure on revenue account was caused by increase in wages, but against this they had run 45,000 additional car-miles; the maintenance was a little higher and rates were also higher, etc. As regards traffic up to July, the traffic showed an increase from October 1, 1913, of £1,255, compared with the same 10 months in the previous financial year, but in August, upon the declaration of war, the visitors fled, and the traffic receipts fell from day to day, and eventually the company made a loss of over £4,000. But for the war, not only would the company have made that £4,000, but the directors anticipated that there would have been an additional £2,000, and electrical lighting would have been considerably increased. Up to the end of the financial year the sale of electricity showed an increase of £1,306, or nearly 13 per cent. over last year. The directors did not see their way to pay a dividend on the preference shares at the present time, but hoped to be able to pay 2½ per cent. later. The chairman then formally moved that the directors' report and accounts for the year ended September 30, 1914, be received and adopted. This was seconded by Mr. Henry Brown and carried unanimously.

The retiring directors and the auditors having been re-elected, the proceedings closed with a vote of thanks to the chairman and directorate.

CAPE ELECTRIC TRAMWAY COMPANY.

A SUCCESSFUL YEAR.

Tho report for the year ended June 30, 1914, shows a gross profit of £78,867, and after providing for debenture interest, redemption of debentures, and including the balance brought forward from last year, there is a credit balance of £32,618. From this sum £8,000 has been placed to the reserve fund, leaving a credit balance of £24,618. A comparison of the traffic results of the Cape Town Tramways for this and the previous year is as follows:

	1914.	1913.	Increase.
Passengers carried	16,576,992	14,779,709	+ 1,797,283
Total earnings	£155,472	£144,222	+ £11,250
Operating expenditure	86,284	77,859	+ 8,425
Gross profit	69,188	66,363	+ 2,825

The Port Elizabeth Tramways give the following results:

	1914.	1913.	Increase or Decrease.
Passengers carried	4,309,154	4,155,711	+ 153,443
Total earnings	£44,937	£43,036	+ £1,901
Operating expenditure	27,716	25,311	+ 2,405
Gross profit...	17,221	17,725	− 504

The directors remark that the labour troubles on the Rand, which resulted in a general strike in 1913, were followed by a recrudescence of the same troubles in January, 1914. They affected the general business situation throughout South Africa disadvantageously, and checked to a certain extent the otherwise satisfactory advance in the earnings of the tramways both in Cape Town and Port Elizabeth. In spite of this check, however, the receipts show satisfactory advances as indicated above, but owing to the increase in the cost of maintenance and operating charges, and to the income tax lately imposed by the Union Government, the net profit is less than that of the preceding year. The additions to the rolling stock and to the power plant at Port Elizabeth have now been completed. Owing to the disturbed financial outlook created by the war, the directors thought it prudent to recommend a dividend of only 2½ per cent. against 5 per cent. in the preceding year.

Mr. J. A. Barkley, general manager of the Cape Town companies, reports that during the year a garage has been erected, and two extra car bodies have been received. An underground water storage tank, with a capacity of 32,500 gallons, was also built in order to ensure an adequate supply of water at all times. For the past few years the increased passenger traffic has necessitated the running of cars of large seating capacity from 40,000 to 45,000 miles per annum. This excessive mileage has interfered with the work of repairing the cars, but now that the new cars are in service the older ones are gradually being sent through the shops for overhauling.

Mr. W. H. Fremantle, general manager of the Port Elizabeth Tramway Company, Limited, reports that the new boilers and generating plant ordered at the commencement of the year were put in service on June 22, and promise to reduce considerably the coal consumption. The company no longer require to obtain power from the municipality. The new cars have also been received.

BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

In their report for the year ended June 30, 1914, the directors state that the result is not as satisfactory as those to which the shareholders have been accustomed in the past. In order to maintain the usual dividend it is necessary to supplement the profits by the transfer of £10,000 from the reserve. This course has been recommended with some hesitation by the directors in view of the unfavourable outlook for the current year caused by the war, but they wish to avoid throwing any additional hardship on the shareholders at the present time, and for that reason propose to draw on the reserve. The sum of £152,377 has been charged against the revenue account for the year, and the net profit remaining is £393,956. To this is added the £10,000 from reserve and £9,519 brought in, making £413,475. It is proposed to pay a final dividend of 4 per cent. on the deferred stock, making 8 per cent. for the year, and to carry forward £6,884. The income for the year was £410,229, against £401,836 in 1913, and the balance available for dividend was £260,965, against £256,242. Owing to the depression the large employers of labour in British Columbia have been forced to postpone all new work, and as a result there has been a decrease in the

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population of Vancouver and the neighbouring districts of approximately 20,000 inhabitants. The financial effect of this decrease would have been more marked but for a small advance in fares put in force in September, 1913. The expenditure on capital account has been reduced to a minimum. The directors announce with regret that Mr. Buntzen, who retires from the board, has decided not to seek re-election owing to his continued residence in Denmark. He has, however, consented to accept the position of adviser to the board. During the first eight years of the company's existence Mr. Buntzen was general manager in British Columbia, and the company owe him a debt of gratitude for his close attention to its affairs. The board has appointed Mr. George Kidd to succeed Mr. Sperling as general manager. Mr. Kidd was formerly secretary, and recently controller of the company, and the board have confidence that they have secured a very capable successor to Mr Sperling.

British Electric Traction Company has paid a dividend on the 6 per cent. preference stock for the half-year ended September 30.

New South Wales Tramways.—The report for the quarter ended September 30 last shows that the earnings were £480,447, being an increase of £50,433, and the working expenses were £407,628, an increase of £20,748. The length of line open is 215 miles.

United Electric Tramways of Montevideo.—The directors of the United Electric Tramways of Montevideo, Limited, announce an interim dividend at the rate of 4 per cent. per annum (2s. per share), less income tax, on the ordinary shares for the past half-year.

The Yorkshire (West Riding) Electric Tramways Company.—The directors have decided to pay a final dividend on January 1 of 3 per cent., being at the rate of 6 per cent. per annum on account of the dividend accrued on the 6 per cent cumulative preference shares.

Cordoba Light, Power, and Traction Company.—After providing for debenture interest, etc , the net profits for the year ended September 30, including £23,501 brought forward, were £44,321. The dividend on the preference shares has been paid, leaving £26,321 to be carried forward.

Melbourne Tramway and Omnibus Company.—The London Secretary of the Melbourne Tramway and Omnibus Company, Limited, has received cable advice from Melbourne of the declaration of a dividend of 6d. per share for the quarter ending December 31, and also a bonus of like amount, making 1s. per share.

Costa Rica Electric Light and Traction Company.—Profits for the year ended June 30 were £26,351, an increase of £2,476. The net surplus profit is £8,056, which the directors propose to write off issue expenses. The number of lamps installed in the lighting department has increased by 11 per cent. during the 12 months, and the power supply by 40 per cent.

Douglas Southern Electric Tramways.—In the report of this undertaking for the year ended October 31, 1914, it is stated that the company's season consisted of 112 days, as compared with 126 days last year. The total traffic receipts were £3,840, as compared with £6,492 for the previous year. The great decrease in the number of passengers carried was entirely attributable to the war. The directors recommended a dividend of 1½ per cent. upon the 7 per cent. preference shares, carrying forward £317. Last year the full dividend was paid on the preference shares and 3¾ per cent. on the ordinary shares.

Lancaster and District Tramways Company.—At the annual meeting in Lancaster on November 28, Mr. A. Bell, who presided, said that the receipts, which amounted to £5,495, showed a decrease of £1,027. They had been able to reduce the expenditure by £744. Down to the beginning of August they were doing extremely well, but when the war broke out the result on their receipts was disastrous. On September 18 the War Office took over their motor omnibuses on fair terms, but within a few days they would have the delivery of new omnibuses, and would restart the service as soon as possible. The report was adopted.

Blackpool, St. Anne's, and Lytham Tramways.—In the report for the year ended October 31 the directors state that the traffic receipts show a very considerable decrease, due entirely to the outbreak of war. Under the circumstances the trustees for the debenture holders have decided to make no distribution of interest on the debenture stock. The net revenue amounted to £24,627, as compared with £29,146 in the previous year. The expenses were less by £1,700, but the balance available for distribution is only £2,274, against £5,056 a year ago. The debit balance on the profit and loss account at the end of the previous financial year was shown as £34,103. The usual sum of £1,500 has been placed to the sinking fund, and £7,500 is required for interest on debenture stock. This brings up the total debit to £43,103, and when the £2,274 profit on the revenue account is set off against it, there is a deficiency of £40,828 to carry to the balance sheet.

Morecambe Tramways Company.—The annual meeting of this company was held in Morecambe on Saturday, November 28, when accounts were presented showing a disposable balance of £916, out of which the directors proposed a dividend of 2 per cent., absorbing £330, and allowances of depreciation on rolling stock, £360, and on the track of £150, leaving £76 to carry forward. Mr. W. H. Pickles, who presided, said that in view of the circumstances the result of the year's working must be regarded as fairly satisfactory. After the declaration of war the receipts fell off very considerably, and for three months showed a reduction of 21 per cent. The motion for the adoption of the report was agreed to, and Mr. G. H. Petty, manager and secretary of the company, said that they were fortunate to be able to pay a dividend at all. He was afraid they must not expect too much from next year's working. The staple trade of Lancaster was very much disorganised, and the earning power of the people was greatly reduced. Until something like normal conditions prevailed he was afraid they could not expect a very great amount of money coming into Morecambe.

East India Tramways Company.—At the meeting of this company on November 30, the chairman said that for the past year the result was on the whole satisfactory. Although petrol, wages, etc., had increased their working expenses by £1,069, the amount available for dividend, owing to the fact that they did not need to place so large an amount to reserve as last year, was greater. Moreover, the bad result of their road motor vehicles experiment was compensated by the experience they had acquired, which showed that the operating expenses per passenger-mile were fully twice as much as of the company's motor tramcars at Karachi, thereby indicating in how little danger the company's tramway business was of being prejudiced by competition with motor omnibuses or chars-a-bancs. So far the company's business had not suffered much from the war, and as the Indian wheat crops were promising, subject to unforeseen contingencies, the prospects for the ensuing year appear favourable. A dividend of 10 per cent. was declared. As £20,000 of accumulated profits were capitalised last year, this year's dividend on the increased capital is equivalent to 16⅔ per cent. on last year's capital.

Newcastle-on-Tyne.—At the annual meeting of the Newcastle Tramways Committee, held on November 25, Alderman J. H. Rodgers, who was re-elected chairman, made a review of the results of working the tramways during the six months ended September 30. In that period, he said, the cars carried 31,043,032 passengers, showing an increase of 3,044,133 over the corresponding six months of last year. The gross traffic receipts were £136,858, an increase of £13,852. The miscellaneous receipts brought up the total revenue for the period to £142,066, an increase of £14,322. The total expenses amounted to £80,179, an increase of £6,912. Part of the increase was due to concessions granted to the men. After allowing for capital charges, income tax, etc., there was a surplus of £17,522, compared with £16,820. Out of this net surplus they contributed to the rates £9,000, against £6,000 in the corresponding half-year. Their contribution to the Tyneside Company had been £5,435, against £4,158. The figures were perfectly satisfactory, but there was no margin for any concessions It would take all the profits of the next half-year to keep up the reserve fund to its full amount of £100,000.

Erith Tramways.—The annual report on the electricity and tramway undertakings, which has been submitted to the Erith Council by Mr. A. Coveney, states that the last extension of the generating station resulted in marked economies. With the continual steady growth and output of the station it must be obvious that the question of future extension cannot be postponed. The London County Council's proposals to seek Parliamentary powers in regard to bulk supply may have the effect of influencing the committee as to incurring additional expenditure on the undertaking. Whilst Mr. Coveney is not satisfied that the bill will pass through Parliament in its present form, he thinks it is within the range of possibility that some compromise may be arrived at which will have the effect of minimising the opposition, and perhaps in five or ten years' time the bulk supply may be available, but if this part of the Council's business is to proceed they cannot hold up the question of extension pending the advent of a bulk supply. On the tramways the gross profit was £4,644 (increase £489). The increase in revenue was £1,916, and in working expenses £1,427. The net deficiency was £1,672 (compared with £2,142), an improvement of £470, although there was a large increase in cost of repairs to permanent way and cars, and in wages of motormen and conductors.

Car Overturned at Barnsley.—A tramcar descending a very steep gradient in Eldon Street North, Barnsley, on December 2, broke away, and after travelling about 500 yards, left the track at a curve, ran across the road for about 20 yards, and crashed into a shop. Two passengers were fatally injured. At the inquest the coroner, in summing up, said he thought that there was no criminal neglect on the part of the driver and conductor of the car, though they had been very careless. He thought that the rules should be more stringent, and the driver ought not to leave his car without notifying the conductor, while the conductor ought not to release the brakes so as to start the car before making sure that the driver was in his place. The jury returned a verdict of accidental death, and expressed the opinion that there had been carelessness on the part of the driver and conductor.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls.	Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	*May 31, 1914	Dec., 1899	E.	27	72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington	*Mar. 31, 1914	Aug., 1907	,,	10	53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne	*Mar. 25, 1914	Aug., 1902	,,	8	15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1914	Sept., 1901	,,	9	30	...	...	...	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham	*Mar. 31, 1914	Jan., 1904	,,	114	44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,915,559	438,545	186,154	628,016	7,455	635,471
Blackburn	*Mar. 25, 1914	Mar., 1899	,,	24	63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool	*Mar. 31, 1914	June, 1899	,,	(p)21	33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	*Mar. 31, 1914	Dec., 1899	,,	47	19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford	*Mar. 31, 1914	July, 1898	,,	h106	29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	*Mar. 31, 1914	Nov., 1901	,,	17	15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	*Mar. 31, 1914	Dec., 1901	,,	22	18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	*Mar. 31, 1914	Aug., 1903	,,	10	50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1914	June, 1903	,,	21	2	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l)29,518	69,745	335	70,080
				(b)13	21											
Chester	*Mar. 25, 1914	April, 1903	,,	6	35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield	*Mar. 31, 1914	Dec., 1904	,,	5	8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester	*Mar. 31, 1914	July, 1904	,,	7	75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,599
Croydon	*Mar. 31, 1914	(q)Sept., 1901	,,	17	50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington	*Mar. 31, 1914	June, 1904	,,	8	71	107,500	77,832	29,668	77,786	8,752	56,178	25,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1914	Oct., 1900	,,	7	13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,005	16,634
Derby	*Mar. 31, 1914	July, 1904	E.	22	20	...	...	...	245,332	11,026	177,676	67,656	(l)32,356	E.51,126	1,048	52,174
			H.			...	...	...	...	...	...	...	...	H 429	19	448
Doncaster	*Mar. 31, 1914	June, 1902	E.	12	58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1914	July, 1900	,,	28	32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham	*Mar. 31, 1914	June, 1901	,,	14	5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	*Mar. 31, 1914	April, 1905	,,	7	0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester	*Mar 31, 1914	April, 1904	,,	15	1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	*Mar. 31, 1914	June, 1898	,,	55	39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	Mar. 31, 1913	Mar., 1903	,,	11	28	149,633	149,633	Nil	149,500	13,171	101,912	39,721	5,611	24,361	2,407	26,768
Ilkeston	*Mar. 31, 1914	May, 1903	,,	3	56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	*Mar. 31, 1914	Nov., 1903	,,	14	70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6	9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock	*May 15, 1914	Dec., 1904	,,	5	47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy	*May 15, 1914	Feb., 1903	,,	8	65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster	*Mar. 31, 1914	Jan., 1903	,,	4	65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	*May 15, 1914	Aug., 1905	,,	17	73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	*Mar. 31, 1914	Dec., 1906	,,	18	8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1914	Nov., 1905	S.	2	77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool	Dec. 31, 1913	Nov., 1898	E.	119	0	...	...	...	2,024,706	17,014	1,177,384	1,091,771	428,318	677,881	13,018	690,899
Lowestoft	*Sep. 30, 1914	July, 1903	,,	4	6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone	*Mar. 31, 1914	July, 1904	,,	7	3	82,932	82,932	...	79,098	11,239	65,574	17,358		10,391	575	10,966
Manchester	*Mar. 31, 1914	June, 1901	,,	202	48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	*Mar. 31, 1914	Feb., 1903	,,	3	69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	*Mar. 31, 1914	April, 1903	,,	14	28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham	*Mar. 31, 1914	Jan., 1901	,,	...		...	...	...	667,705	...	410,091	237,501	68,372	172,731	2,648	175,379
Oldham	*Mar. 25, 1914	May, 1902	,,	28	6	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
				(b) 8	31											
Perth	May 15, 1913	Nov., 1905	,,	6	60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth	*Mar. 31, 1914	Sept., 1899	,,	15	0	...	...	...	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd	Mar. 31, 1913	Mar., 1905	,,	8	48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall	*Mar. 31, 1914	May, 1909	,,	15	71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	*Mar. 31, 1914	May, 1902	,,	(i) 40	2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham	*Mar. 31, 1914	Jan., 1903	,,	12	2	...	183,775	...	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...		...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	*Mar. 31, 1914	Oct., 1901	E.	75	64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton	*Mar. 31, 1914	Jan., 1900	,,	18	54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11	49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport	*Mar. 31, 1914	July, 1900	,,	(d) 10	63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields	*Mar. 31, 1914	Mar., 1906	,,	10	21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l)26,881	37,744	586	38,330
Staly'ge, H., M., D.	*Mar 31, 1914	May, 1904	,,	27	57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport	*Mar. 31, 1914	Aug., 1901	,,	27	5	...	...	...	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland	*Mar. 31, 1914	Aug., 1900	,,	20	28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey	*Mar. 31, 1914	Mar., 1902	,,	19	77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1913	Dec., 1902	,,	19	44	188,145	188,100	45	183,351	9,378	159,561	58,366	33,873	32,991	682	33,673
Walthamstow	*Mar 31, 1914	June, 1905	,,	13	30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington	*Mar. 31, 1914	April, 1902	,,	9	52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham	*Mar. 31, 1914	Feb., 1904	,,	30	4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	*Mar. 31, 1914	April, 1901	,,	30	73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	*Mar. 31, 1914	April, 1902	S.	21	40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)	*Mar. 31, 1914	June, 1902	E.	14	58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	*Mar. 31, 1914	Jan., 1910	,,	12	20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1914	Nov., 1905	E.	98	54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	*Mar. 31, 1914	Oct., 1903	,,	6	42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	*Mar. 31, 1914	Feb., 1901	,,	24	7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth	*Mar. 31, 1914	July, 1902	,,	(e) 29	62	432,440	...	...	443,006	19,821	286,385	146,054	18,403	104,353	616	104,969
Cardiff	*Mar. 31, 1914	May, 1902	,,	31	66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry	*Mar. 31, 1914	Jan., 1912	,,	15	61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1914	Oct., 1898	,,	193	40	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
				(b) 2	53											
Huddersfield	*Mar. 31, 1914	Feb., 1901	,,	48	41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	*Mar. 31, 1914	July, 1899	,,	33	12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	*Mar. 31, 1914	Aug., 1897	,,	114	5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester	Dec. 31, 1913	May, 1904	,,	37	0	929,120	727,405	201,715	739,982	19,999	602,478	129,807	100,000	147,458	17,059	164,517
London	*Mar. 31, 1914	...	H.	13	73				...	...	...	...	...	21,145	480	21,635
		May, 1903	C.E	277	26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	*Mar. 31, 1914	Dec., 1901	E.	62	72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,537	251,024	10,177	261,201
Northampton	*Mar. 31, 1914	July, 1904	,,	9	16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth	*Mar. 31, 1914	Sep., 1901	,,	34	51	708,618	708,618	..	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	Mar. 31, 1913	June, 1904	,,	17	16	224,102	187,270	36,832	187,269	10,888	119,790	42,091	36,841	42,964	306	43,270
Reading	*Mar. 31, 1914	July, 1903	,,	13	14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	*Mar 25, 1914	Sep., 1899	,,	79	3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	*Mar. 31, 1914	...	,,	31	55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system
(b) Additional lines leased and worked. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1¼ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses. Traffic.	General.	Repairs & Maintenance.	Power.	Total.	Gross Profit on Working.	Additions to Gross Profit.	Deductions from Gross Profit. Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal.	Sundries.	Total.	Net Surplus + or Deficit −
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,033	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	35,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	..	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,482	2,424	4,116	4,279	20,301	6,467	557	4,894	4,146	...	...	...	9,040	− 2,016
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3 624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1.116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9.742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	180.226	61.361	84,026	121,185	446.798	244,101	24,220	48,971	60,318	...	(d) 54,163	(e) 4,869	168,321	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	(h) 2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1,310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19.977	5.011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,291	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,019	3,201	4,678	5,710	21,608	12,065	1,371	5,191	3,439	458	1,868	...	10,956	+ 2,480
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,563
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(c) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212.642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	..	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,008
Leicester	54,257	10,405	21,566	23,887	110,115	54,402	3,763	23,541	12,453	2,122	7,636	2,413	48,165	+ 10,000
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	(m) 11,671 246,328	30,215 1,585,251	(ef. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18.079	784,349	− 88,526
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	..	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	505	(h) 3,322	4,422	303	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	10,781	4,592	6,263	2,429	24,065	19,205	...	3,933	4,891	..	3,649	1,358	13,831	+ 5,374
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,874 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (f) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses.
(n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account.
(r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit on motor char-a-banc. (z) Includes £6,519 rent of leased lines. ‡ £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Per-centage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	4,011	...	...	14·08	13·46	3·41	·97	2·93	2·06	9·37	66·10	7·37	1,901,668	1·3	1·64
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·38	10·26	2·315	·769	1·213	1·252	5·549	50·44	4·297	2,037,620	1	1·252
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	445	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E 10·358	10·150	3·438	·577	1·092	1·709	6·816	65·8	5·107	1,425,112	1·45	1·179
				H. 6·077	5·821	7·325	...	1·099	...	8·424	138·6	...	...	...	...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	. .	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	7·616	7·464	2·698	·689	1·171	1·218	5·776	76·4	4·558	960,866	1·07	1·098
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·34	12·10	3·217	1·096	1·500	2·164	7·977	63·2	5·813	23,928,396	1·138	1·78
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ..	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	7,013	24,000	...	11·87	3·04	1·04	1·34	1·92	7·34	61·82	5·42	5,359,804	1·25	1·51
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale... ...	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ...	4,287	750	12·54	12·52	2·92	·87	2·22	2·79	8·80	70·15	6·01	1,731,184	1·375	2·03
	R.T....	1,009	...	10·74	10·74	2·44	·76	2·68	1·23	7·11	66·20	5·88	120,303	1·375	1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport ...	.	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	1,480	...	1,000	11·234	11·007	2·675	1·068	1·561	1·905	7·209	64	5·304	845,654	1·68	1·176
Walthamstow ..	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1⅛	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ..	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester... ..	...	...	10,000	9·801	8·785	3·232	·620	1·285	1·423	6·560	66	5·137	7,141,333	·411	1·77
London	...	...	...	E. 9·21	8·94	3·32	·76	1·41	1·01	6·50	70·55	5·49	154,048,461	·601	2·63
				H. 8·15	7·97	4·07	1·39	1·53	4·40	11·39	139·72	11·39	...	...	...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,374	...	10·698	10·50	2·665	1·135	1·550	·600	5·95	55·63	5·35	1,516,545	·384	1·309
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30,581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Traffic Records. Car Mileage.	Passengers Carried.	Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Popular'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		*d.*	*Miles.*	*d.*	*Miles.*			
Aberdeen ...	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10/3	·508	1·80	·58	7·5	703	54	77
Accrington...	45,525	873,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11/1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,244	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,149,462	12,731,532	11·07	1·28	63·15	105	2,751	6/10	·88	1·25	·76	7·5	448	32	61
Blackpool ...	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24/9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6·3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10 10	·543	1·24	·85	8·51	483·83	45·26	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5/5	·78	1·38	·75	7·33	126	7	17
Colchester ...	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4/8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon ...	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9.10	·871	2·05	·50	8·14	942·23	59	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935			...	...	1·35	1	1	..	...	..	3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8/2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax ...	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12/4	·867	1·30	·87	7·23	853·93	77	101
Ilford ...	82,000	843,817	7,578,813	8·79	·831	92·42	...	2,312	5/1	·64	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52·8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·06	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	183	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6/11	·532	1·75	·428	7	90	5	8
Liverpool ...	839,000	13,442,605	144,085,927	10·72	1·129	172	77	5,695	16/2	·744	2·514	·39	7·5	4,920	480	595
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	8·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	...	...	...	662
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,824	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,843,669	40,535,874	11·43	1·02	155	92·72	...	13/2	·642	1·70	1	6·86	...	105	135
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	17/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	...	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9,333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd...	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·81	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10/9	·751	1·13	·88	9	247·5	15	24
Rochdale ...	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham...	64,000	E 852,639	9,874,231	11·58	1·08	154·3	...	3,701	13/9	·76	...	...	...	...	...	...
	...	RT 128,685	471,690	3·67	2·72	...	...	...	...	1·92	...	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543,941	13,162,224	8·52	1·23	108	77·38	3,624	11/1	·82	1·25	·85	...	...	...	70
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	..	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	719,372	6,121,381	8·509	1·293	61	86	1,885	6/7	·847	1·24	·79	7	345	23	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham...	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·51	7·75	1,235	95	118
Wigan ...	200,000	1,500,846	14,295,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,865,891	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley ...	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow ...	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds ...	525,000	9,204,331	93,673,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester ...	230,970	4,028,542	37,073,717	9·202	·954	161	...	3,985	12/9	·712	2·18	·984	8	...	...	150
London ...	...	E58,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·08	17,728·8	1,335	1,722
		H 636,933	6,613,781	10·38	·77	...	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	14·40	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6·4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120,000	970,719	9,567,366	9·85	1·06	79·73	132	2,498	7·2	·603	1·01	·95	7·36	...	...	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	479,622	8,883,876	104,851,408	11·803	·884	218·594	104·644	4,885	16/1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington...	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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NEW CONTRACTS AND ORDERS.

The Workington Steel Company have secured an order for 6,000 tons of steel rails for Tasmania.

Siemens Brothers Dynamo Works, Stafford, have an order for rotary converters for Walsall Electricity Committee.

Durham, Churchill, and Company are to supply a 45-H.P. 3-ton motor chassis to Sheffield Tramways Committee, at £650.

Babcock and Wilcox, Limited, have an order from West Bromwich Council for steelwork and extensions to the boiler house.

The Union Cable Company, Limited, have an order for electric cables from Dewsbury Electricity and Tramways Committee.

Walter Scott, Limited, are supplying rails for tramway extensions for South Shields at £7 10s. per ton, plus 8s. per ton for royalty.

The British Westinghouse Company have an order for 82 brake magnets and 32 skid-proof attachments from Rochdale Tramways Committee.

Bradford Electricity Committee have accepted the tender of the Sturtevant Engineering Company for an air filter for a 5,000-KW. turbo-alternator.

The Municipal Council of Sydney have placed an order with the Australian General Electric Company for three 2,000-K.V.A. transformers, at £5,097.

Mr. J. W. Pearce, of Doncaster, has been awarded a contract for the construction of tramway track in Hull Road, York, by the York Corporation, at a cost of £22,203.

A. Reyrolle and Company, of Hebburn-on-Tyne, have received an order from the Sheffield Electricity Supply Committee for 24 overload relays for sub-station switch gear.

The Paterson Engineering Company, Limited, have received an order from Paisley Town Council for water filtering plant capable of treating 5,500,000 gallons in 24 hours.

The Bhavnagar State Railways have placed an order with the Motor Rail and Tramcar Company for a 50-passenger rail car, to be equipped with the Dixon-Abbot transmission gear.

The British Westinghouse Electric and Manufacturing Company have an order from the Walsall Electricity Committee for three sub-station static transformers and for sub-station switch gear.

Blackpool Corporation have placed an order with Cole, Marchent, and Morley for a 25,000 lb. surface condensing plant, and with the British Insulated and Helsby Cables, Limited, for high-tension cable and trolley wire.

Clough, Smith, and Company, Limited, Spencer House, South Place, London, E.C., have secured from the Bradford Corporation the contract for the erection of a 6,600-volt, high-tension transmission line from Bolton Hall Road to Round Wood, Esholt.

Glasgow Corporation Tramways.—Among the tenders recommended for acceptance by the Tramways Committee are the following: Special trackwork, Titan Trackwork Company; scrap copper, P. and W. McLellan; armature coils and vulcanised cable, Shearer Brothers.

The Cunard Steamship Company, Limited, have accepted the tender of the General Electric Company for 12 months' supply of Osram ship lighting lamps, and of the Edison and Swan United Electric Light Company for 12 months' supply of Royal Ediswan lamps.

New Brakes for Sheffield.—The Spencer brake has now been in service on one of the Sheffield cars for the last few months, and Mr. A. R Fearnley, the general manager, has recommended the purchase of nine of these brakes at £100 each from Cole, Marchent, and Morley, Limited.

The Motor Rail and Tramcar Company have recently completed for Lombardy Road and Railways Company two chassis equipped with the Dixon-Abbot transmission gear. These chassis are precisely the same as those on the East India tramways, which have proved so successful during the past five years.

Colwyn Bay Electricity Committee have accepted the following tenders for the new power-station: Turbines and alternators, Belliss and Morcom, £7,990; boilers, Stirling Boiler Company, £3,701; switch gear, British Westinghouse Company, £7,900, and British Thomson-Houston Company, £585; rotaries, British Thomson-Houston Company, £1,547.

The British Thomson-Houston Company's tenders have been accepted as follow:

Blackpool Corporation, a 1,500-KW. turbo-alternator;
Barrow-in-Furness Corporation, 2,000-KW. alternator, with condensing plant, at £6,718;
Torquay Town Council, duplicate set of turbines (£3,837) and condensing plant (£1,247), and rotary converter (£1,163);
Coventry City Council, turbo-alternator, £10,875.

The Woods-Gilbert Rail Planer Company, Limited, 2 and 3, Norfolk Street, Strand, London, W.C., are carrying out contracts for Cardiff Corporation Tramways and the Isle of Thanet Tramways, where the rails are being remodelled by their process. This consists in deepening the rail groove, smoothing the tread and joints, and removing high checks. This is expected to increase the life of the rails about 50 per cent. The Woods-Gilbert process was described and illustrated in our issue of October 16, 1913, when an account was given of the work which had been successfully carried out in Sydney, Melbourne, Brisbane, and Ashton-under-Lyne.

Coventry City Council have accepted the following tenders: Turbo-alternator, British Thomson-Houston Company, Limited, £10,810; four marine-type boilers, Babcock and Wilcox, Limited, £11,166 8s.; four double stokers, Bennis and Company, Limited, £2,220; four economisers, Green and Son, Limited, £3,524; bunkers, boiler-house framework, and coal and ash handling plant, Bennis and Company, Limited, £11,016; induced draught plant, Babcock and Wilcox, Limited, £3,595; pipework, Stewarts and Lloyds, Limited, £2,486; cast-iron tank, Matterson and Company, Limited, £360; cooling towers, Worthington Pump Company, Limited, £3 260

Walsall Tramways Committee have accepted the following tenders for annual supplies: National Rail and Tramway Appliances, brake blocks; Siemens Brothers and Company, tantalum lamps; Alfred Wiseman, Limited, pinion wheels; S. Peace and Son, strand wire; British Insulated and Helsby Cables, mechanical ears; Anti-Attrition Metal Company, trolley wheels; Dermatine Company, point rubbers; Dyer and Young, controlling fingers; J. North Hardy and Son, linen frame tape and linen tape; British Thomson-Houston Company, paragon tape and acme tape; P. R. Jackson and Company, armature coils; Heap and Johnson, carbon brushes; Pinchin, Johnson, and Company, air drying voltalac; Glacier Anti-Friction Metal pany, gearing metal; Slack, Sellars, and Company, track saw blades.

TRAMWAY AND OMNIBUS BILLS.

The following are among the private legislation proposals of all kinds which will be brought before Parliament during the present year:

BRISTOL TRAMWAYS AND CARRIAGE COMPANY propose to make application with respect to the revival of powers and extension of time for the compulsory purchase of lands and for the completion of authorised tramways. The tramways in question are proposed extensions of some of the present routes into the country beyond the existing city boundaries.

DUNFERMLINE.—Notice has been given that an application will be made for a Provisional Order to authorise the construction of a tramway between Dunfermline and Rossyth dockyard. It is also proposed to link up Inverkeithing and the Forth Bridge district with the West Fife tramway system.

EDINBURGH CORPORATION.—The Town Council of Edinburgh are applying for a Provisional Order to enable them to construct tramways and a tramroad, principally in the Colinton and Corstorphine districts. Various short-junction lines are also proposed.

LINCOLN CORPORATION are promoting a bill to provide for the use of railless vehicles and the erection of overhead equipment on certain routes within and outside the city and for working motor omnibuses; also to purchase land for the extension of the generating station.

LONDON COUNTY COUNCIL. The official notice has been issued of the bill which the London County Council are promoting in Parliament for the construction of tramways and the widening of streets. The new lines are proposed to run from Charles Street to Charterhouse Street, from Aldgate to near Mark Lane, from Crouch Hill to Seven Sisters Road, from Mare Street to Terrace Road, and from Church Crescent and Shoreditch High Street to Cambridge Road. Some of these lines have been proposed in previous sessions, but were not sanctioned. It is also sought to obtain authority to run coupled and trailer cars on the north side of the Thames. This authority already exists in regard to the lines south of the river.

PLYMOUTH CORPORATION TRAMWAYS.—In the bill which is being promoted by Plymouth Corporation power is sought by which the Corporation may work any tramways now or hereafter belonging to the Corporation and all other tramways in the borough, including those owned and worked by or leased to the Devonport and District Tramways Company, and the Plymouth, Stonehouse, and Devonport Tramways Company; also to exclude the last-mentioned from some or all the provisions of the Acts now relating thereto, and repeal those provisions with such exceptions as may be indicated in the bill. The Corporation by the provisions of the bill would also be authorised to provide and run motor 'buses within the borough. Another point of general interest is the proposal to transfer to and vest in the Corporation the Cottonian Museum, now housed in Cornwall Street.

ROTHERHAM CORPORATION have deposited a bill asking for powers to construct and work new tramways, and for compulsory running powers over the Sheffield Corporation lines; also for the use of motor omnibuses, etc.

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PERSONAL.

Scholey and Company, Limited, have removed their offices to 56, Victoria Street, Westminster, S.W.

Mr. A. B. McDonald, the retiring city engineer of Glasgow, has been granted by the Corporation a retiring allowance of £500.

Mr. A. Beasley, general manager of the Taff Vale Railway, has been elected chairman of the General Managers' Conference for 1915.

Mr. M. E. Curwen, European manager of the J. G. Brill Company, left London on November 17 on his annual visit to the United States.

Mr. W. Phillips has been appointed European railway and steamship manager to the Canadian Northern Railway, in succession to Mr. Scott Griffin.

Mr. W. E. Mandelick, the secretary of the Underground Electric Railways Company of London, sailed on November 17 for his annual trip to the United States.

Mr. F. French has been appointed deputy borough electrical engineer of Bridlington in the absence, on active service, of Mr. A. J. Beckett, the borough electrical engineer.

Mr. Ernest B. Martin, borough and also tramways permanent way engineer of Rotherham, has been appointed as borough engineer of Salford, in succession to the late Mr. Joseph Corbett.

Mr. S. Hann, borough electrical engineer of Stoke Newington, has joined the Royal Naval Division (Public School section), his Council having granted him leave of absence for the purpose.

Alderman J. H. Rodgers, who was recently re-elected chairman of Newcastle-on-Tyne Tramways Committee for the sixth time, has now been chairman and vice-chairman of the committee for nearly 11 years.

Mr. J. A. Robertson has been voted an honorarium of £200 by Greenock Corporation for his services during seven months in connection with the extension of the electricity supply to Port Glasgow. Mr. Robertson is now engineer at Salford.

Mr. Joseph L. White, traffic superintendent of the Lanarkshire Tramways Company, has been presented by the staff and employees with a silver tea and coffee service on the occasion of his marriage. Mr. G. F. Moller, general manager, made the presentation on behalf of the men.

Mr. J. C. Cameron, who was recently appointed manager of the Northampton Tramways, came to Northampton in 1904 as an engineer for the International Electrical Engineering Company, who were engaged in the erection of the power-station. For the past seven years he has been chief electrical engineer of the station. He is the son of Mr. John Cameron, manager of the Blackpool and Fleetwood Tramroad Company.

Mr. Herbert Ashcombe Walker, general manager of the London and South Western Railway, has had conferred on him the honour of knighthood, his name appearing in the New Year list of honours. Sir H. Walker became manager of the railway in January, 1912, in succession to Sir Charles Owens. For many years before that he had been in the service of the London and North Western Railway. Indeed, it was in the office of a district superintendent of that railway that he began his career.

Mr. Manners, the general manager of the Malta Tramways Company, returned to Valetta at the end of November after a visit to London on business. The *Malta Daily Chronicle* in referring to Mr. Manners' arrival, alluded to "the very satisfactory working which characterises the present management of the company. There is nothing more distasteful to us," the journal adds, "than to have to give expression to public complaint, and it is all the more agreeable to be able to testify to the high approval of the management by passengers on the different lines. We are glad to be able to pay a tribute to Mr. Manners' energy, which has established a useful and reliable service combining safe working, willing and courteous administration, and efficient control."

Cole, Marchent, and Morley, Limited.—Mr. R. S. Brailsford, Mr. W. W. Spooner, and Mr. A. Brailsford have been appointed directors of this company. They have purchased the entire shareholdings of the late directors, Messrs. H. W. Morley, G. H. Hodgson, and D. H. Illingworth, who, owing to the pressure of other engagements, have now retired from the directorate and management of the firm. Mr. R. S. Brailsford, who becomes chairman of the company, commenced his engineering career at King's College, London, and has had considerable experience with leading firms not only in Great Britain but also in the Colonies, and during the last five years he has been actively associated in the management of the company. Mr. W. W. Spooner has also had wide experience, commencing with the engineering section of Cambridge University, followed by many years with some of the largest engineering firms in this country, including W. H. Allen, Sons, and Company, of Bedford, the British Westinghouse Company, Limited, of Manchester, and Willans and Robinson, Limited, of Rugby.

TRAMWAY AND LIGHT RAILWAY NOTES.

ACCRINGTON.

CARRIAGE OF MAILS.

The Corporation has renewed its agreement with the Post Office for the carriage of mails and Post Office servants on the tramcars for another five years at £175 per annum.

ASHTON-UNDER-LYNE.

THE QUESTION OF TRAMWAY PURCHASE.

The Town Council have deputed a standing sub-committee to consider the advisability of taking over, in conjunction with other neighbouring authorities, the undertaking of the Oldham, Ashton, and Hyde Electric Tramways, Limited. The sub-committee will confer with the neighbouring authorities and report.

BARNSLEY.

AN ABORTIVE STRIKE.

The car and omnibus drivers of the Barnsley and District Electric Traction Company evidently do not share the view of the great mass of working men in this country that the time of a great war is not a time for trade disputes. On Friday, December 18, some 60 of these employees of the company went on strike for an advance in wages of a penny per hour. The strike was settled on the following Monday, and the services were resumed on the Tuesday. The terms of the settlement have not been divulged. The news was received with great satisfaction by the people in the populous district around the town, as the stoppage had occasioned much inconvenience at this busy season of the year.

BIRKENHEAD.

CARRIAGE OF PARCELS.

The Birkenhead Tramways Committee have decided to make a charge of one penny for each package weighing over 28 lb. carried on the tramcars.

BRIGHTON.

EXTENSION OF CAR SHEDS.

At a meeting of Brighton Town Council on November 26, Alderman Griffith, in moving the adoption of the report of the Tramways Committee, said that there was an absolute necessity for an extension of the car sheds. For many years past they had had to keep two cars always standing in the open, and that was very unsatisfactory. Now they had three additional cars completed. The proposed extension provided room for six cars. The whole of the money required could be raised out of capital, and it was proposed that the money should be so raised. When the trackless trolley service came into operation it would be necessary to have a separate depot. The proposal was agreed to.

BRISTOL.

BONUSES FOR EMPLOYEES.

In accordance with their usual Christmas custom, the Bristol Tramways and Carriage Company have distributed £3,000 as long-service and loyalty bonuses to their employees. The bonuses awarded to men on active service have been paid over to their wives or dependents.

CARDIFF

TRAMWAY SHELTERS.

The Tramways Committee of Cardiff recently discussed the provision of shelters at important stopping places, and it was decided that the manager, Mr. Arthur Ellis, should consult with the city engineer, Mr. W. Harpur, on the subject. It was suggested that the shelters should take the form of a sloping glass projection built from the walls of adjoining properties, subject, of course, to the consent of the owners.

DOVER.

EXCESSIVE PRICE FOR ENERGY—EXTENSION AT GENERATING STATION.

Councillor Ernest Chitty, in expressing his thanks for re-election to the chairmanship of the Tramways Committee, said that although the financial results were now not all they could desire, they looked to the future with more confidence. They were relaying the track, and in another 12 months it would be in very good condition, and then it would be unnecessary to spend so much on the upkeep of the track, and the maintenance of the cars, which had suffered badly from the state of the track, would be less expensive. The real trouble with the system was the excessive price they had to pay for current, but the electricity department was doing better, and they hoped that the cost of current would soon be reduced.—The Electricity Committee has reported that owing to the increase in the demand for lighting and traction, additional plant will be required at the electricity works after October next. The engineer proposes the installing of a 1,000-KW. turbine, which is twice the capacity of the two machines now in the work.

LONDON.

HALF FARES FOR CHILDREN.

Children under 14 years of age are now allowed to travel on the London County Council tramways for half fares on Saturdays, Sundays, and Bank Holidays.

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GLASGOW.

Car with Revolving Seats on the Upper Deck.

Colonel Druitt, on behalf of the Board of Trade, has now approved of the new car described in our issue of December 10, and it is expected that it will shortly be put into regular service. The principal feature of the car, as already indicated, is the arrangement of the seats on the upper deck, swivelling chairs being provided.

HASTINGS.

Workmen's Tickets.

A man was fined 10s. and costs at Hastings recently for having used a workman's ticket on a tramcar although he was alleged not to be a "workman." It was stated that the defendant was an insurance superintendent. It was surely time that this old attempt to differentiate between classes of passengers on tramcars should be abandoned generally, as it has been on so very many tramways already. The rule is difficult to enforce, the drawing of the line between a "workman" and a "non-workman" is often practically impossible, and there is great temptation to evasion, giving trouble to the tramway officials and lowering the moral rectitude of the minds of the evaders. When cheap fares are granted on certain cars or on all cars between certain hours they should be granted alike to all passengers, irrespective of occupation.

ILFORD.

Manager's Report on Inter-running—The Bane of Halfpenny Fares.

At a meeting of Ilford Urban Council, the Tramways Committee reported that they had considered a report by Mr. L. E. Harvey, the tramways manager, on the question of inter-running with London tramways. Mr. Harvey contended that any such scheme was out of the question. He could see nothing to justify him in recommending the committee to adopt inter-running; and he thought it would be a disastrous thing for them to entertain the idea. In view of this opinion, the committee reported that they were unable to give effect to the Council's instruction to open negotiations with neighbouring authorities, and they recommended that no action be taken. The manager had also submitted his annual report for the year ended March 31 last to the committee. In this he said that the financial result was very bad, there being a deficit of £3,567, due to decrease in receipts from omnibus competition, and increase in expenses from extra mileage run. For the year now current the receipts were much more favourable. He had come to the conclusion that the undertaking would never be a profit-earning concern, and would be a burden on the rates so long as the present halfpenny fares were in existence. The committee instructed the manager to communicate with the undertakings of other towns where a change over from halfpenny fares had taken place and a universal penny fare adopted, with a view to ascertaining their experiences; also to obtain certain other information, and to present a comprehensive report. The committee's proposals were adopted.

LIVERPOOL.

New Turbo-Alternator at Lister Drive Station.

The latest addition to the plant at Lister Drive Station, Liverpool, is a 7,500-K.V.A. turbo-alternator, manufactured by the British Thomson-Houston Company, which was formally started on Friday evening, December 18. The Lord Mayor and a party of guests visited the station and afterwards dined at the Midland Adelphi Hotel, under the chairmanship of Mr. Russell-Taylor, who, in proposing the toast of the Lord Mayor, said that the idea of the night inspection was his own. They now had a generating plant of a total capacity of 17,000 KW., and another machine with a capacity of 6,000 KW. was under construction. Alderman Fred Smith, in proposing the toast of the Electrical Engineer, said they all recognised Mr. Harold Dickinson's capacity and appreciated his services to the Electricity and Tramways Committee. Mr. Dickinson, in replying, alluded to the services of Mr. Bromley Holmes, who, he said, designed the buildings in Lister Drive in such a way that they had been able, without adding to them, to increase the capacity with modern plant.

MANCHESTER.

Tramway Shelter in Albert Square.

The Improvements Committee of Manchester Corporation Tramways have approved a rearrangement of the tracks in Albert Square, so as to bring them nearer to the centre of the square, and to allow the erection of a refuge and shelter for tramway passengers.

OXFORD.

Disappearance of Tramways.

The disappearance of the tramway tracks in Oxford is now only a question of a comparatively short time, as the Highways Committee of the City Council have recommended their immediate removal. The cost of the work will amount to about £23,000, which is to be raised by a loan. The tramcars will be replaced by motor omnibuses.

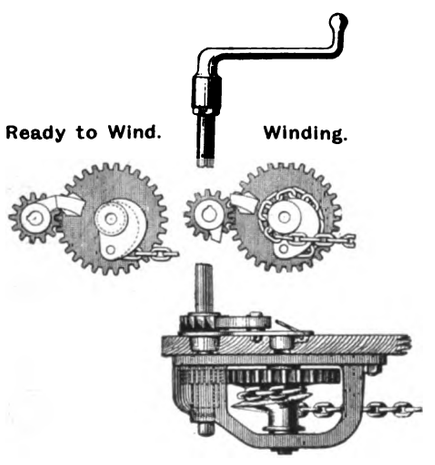
SHEFFIELD.

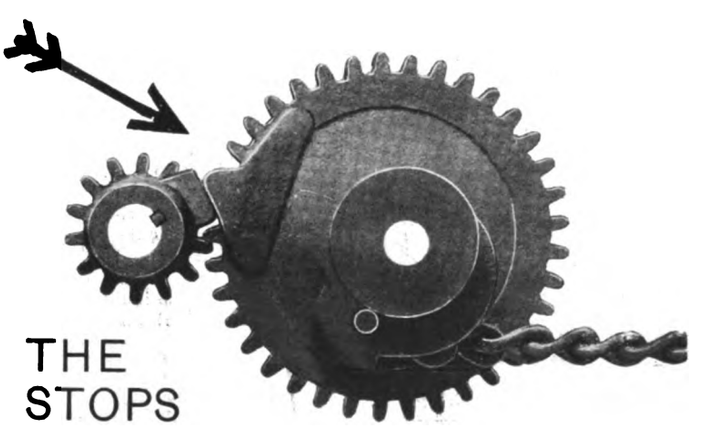
New Brakes.

Sir William Clegg, in referring at a recent meeting of the City Council to the purchase of Spencer-Dawson power brakes for double-deck cars to run on the Intake route, said that if they could get the approval of the Board of Trade they would run double-deckers on the Walkley route.

THE "PEACOCK" IMPROVED BRAKE

(PATENT).





Note the Stops which render this the quickest of all geared hand brakes by

(1) Preventing the drum from over-running on release.
(2) Stopping the drum always at the point from which recovery of slack chain is most rapid; and
(3) Eliminating all idle turning of the handle.

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SOUTHAMPTON.

REDUCTION IN PRICE PAID FOR ENERGY.

Southampton Electricity and Tramways Joint Committee have decided to reduce the charge for electric energy for the tramways by ¼d. per unit after April 1 next.

SWINTON.

BREAKING OF OVERHEAD WIRE.

The breaking of a section of overhead trolley wire caused an interruption of the service on the Swinton Tramways on December 20, between Mexborough and Rotherham. Fortunately few people were in the streets at the time, and no one was injured.

WALSALL.

NEW TRACK CONSTRUCTION.

In connection with a new street, the Walsall Tramways Committee propose to proceed with the construction of a length of tramway at an estimated cost of £3,683.

WEMYSS.

SINKING OF TRAMWAY STANDARD.

A stoppage of the service on the Wemyss and District Tramways occurred on December 7 from a curious cause. One of the poles carrying the overhead wires suddenly sunk into the ground, bringing down part of the overhead work. The stoppage was not wholly removed for several days. The subsidence of a part of the roadway caused by mining work was of such a depth that it was impossible to see the top of a tramway standard which sank. About 150 tons of debris were thrown into the hole before it was brought to the level of the road.

WEST HAM.

CHILDREN'S TICKETS.

Arrangements have been arrived at with the other tramway authorities having through-running agreements with West Ham, under which children's tickets are to be issued on all cars running over the through routes. In the London County Council area children's tickets will be issued on Saturdays, Sundays, and Bank Holidays, but in the Leyton and the West Ham areas the tickets will be issued throughout the week. Children's tickets will not be issued in the East Ham area. The fares apply to children between the ages of five and 14, and in the borough of West Ham are as follows: ½d. fare for ordinary ½d. and 1d. stages; 1d. for ordinary 1½d. and 2d. stages; 1½d. for ordinary 2½d. and 3d stages. The new arrangement makes the practice, so far as children travelling in the borough of West Ham are concerned, quite uniform. Mr. J. S. D. Moffet, general manager of the West Ham Tramways, in reporting to the Tramways Committee some time ago, said that the London County Council was beginning to see the advantage of uniformity and of a simple fare system which everyone could understand, and he hoped that in time children's fares would obtain throughout the week on the whole of the through routes.

YORK.

MILITARY AUTHORITIES TO PAY FOR TRAMWAY EXTENSIONS.

At a meeting of York Corporation, the Tramways Committee reported that an application had been submitted to them on behalf of the military authorities for certain extensions of the tramways, to give them facilities for carrying the large amount of stores which they have to deal with at the present time direct from the railway to the depot. The authorities had intimated that they were willing to advance, if necessary, the moneys for the extensions, estimated at £4,700, and pay carriage, on terms to be agreed upon. The committee asked the Council to authorise them to conclude an arrangement with the military authorities in regard to the proposals. The report was adopted, and contracts for the extensions have since been placed. J. W. Pearce, of Doncaster, has been awarded the contract for the construction of tramways on the Hull Road route. He has also secured the contract for extensions to be carried out at the request of the military authorities. These include the laying of lines from Leeman Monument to the North Eastern Railway goods yard in Leeman Road, and from Fulford Road to the Ordnance Stores. It is expected that the construction of the Hull Road route and the extensions for the military authorities will be commenced early this month, and the latter-named work will be expedited as much as possible.

INADEQUATE SALARIES OF JUNIOR ENGINEERS.

Speaking at a recent meeting of the Birmingham Local Section of the Institution of Electrical Engineers, Sir John Snell said that he felt that the salaries paid to junior engineers were inadequate, and that—after not only a good practical training, but also a good college, and possibly also a university training involving years of work and much expense—engineers had a right to expect higher remuneration, and not some paltry sum of 25s. a week. He hoped that attention would be given to this matter and that the Institution might be successful in bringing about an improvement in this respect. Electrical engineering now required a prolonged and scientific training and was as much a learned profession as that of the law, and he asked for the co-operation of all the members in securing a proper recognition of the status of electrical engineers.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in *italics*.

APPLICATIONS.

The following Application for Letters Patent have been filed:

23,298 Spring suspension for motor vehicles—R. Warner.
23,342 Axle boxes for railway vehicles—C. H. Woodhead, A. G. Elliott, and M. W. Middleton.
23,357 Electric starters for use on motor cars—A. H. Midgley and C. A. Vandervell.
23,368 Automatic regulating apparatus for dynamos—V. A. Trier.
23,375 Suspension of automobile vehicles—R. Esnault-Pelterie.
23,377 Steam superheaters and feed-water heaters for locomotives—A. Spencer.
23,438 Axle boxes for tramway cars—S. Stone.
23,446 } Pneumatic brakes—S. Cheney
23,447 }
23,471 Steering gear of motor cars—A. Thompson and R. Thompson.
23,486 Electric insulators—C. B. Burdon (*Siemens-Schuckertwerke G.m.b.H.*).
23,535 Top-deck seating arrangements of omnibuses—W. J. Hickman.
23,544 Electro-magnetic switches—British Thomson-Houston Company, Limited (*General Electric Company*).
23,573 Mechanical underfeed stokers—Erith's Engineering Company, Limited, and C. Erith.
23,595 Laminated springs for railway and tramway vehicles—S. Osborn and Company, Limited, and F. A. Hurst.
23,641 Signalling and train-stopping apparatus—H. Ballington and L. Shaw.
23,718 Construction and manufacture of wheels—W. Challiner.
23,719 Commutators of electric motors—F. Scales.
23,802 Sleepers for permanent way—C. P. Sandberg.
23,889 Apparatus for controlling railway trains in motion—E. C. Irving.
23,894 Series-parallel controlling systems for electric motors—G. R. Radley.
23,915 Means for actuating brakes or other mechanism on moving vehicles from controlling apparatus on the permanent way—F. Alcock.
23,934 Motor lorries—C. J. V. Christiansen.
23,978 Manufacture of rails—C. P. Sandberg.
23,979 Brakes for railway vehicles—W. Kissack.
24,005 Signalling apparatus—T. Powell.
24,039 Maximum current or overload circuit breakers—W. J. Mellersh Jackson (*Soc. Anon. Movo.*).
24,045 Motor vehicles—A. A. Scott.
24,048 Apparatus for controlling trains in motion—E. C. Irving.
24,055 Regulation for petrol-electric cars—W. A. Stevens.
24,070 Friction brakes for motor cars—T. Raffo.
24,074 Trolley poles or bows for electrical vehicles—G. Meyer.
24,088 Flexible electric cables—W. T. Henley's Telegraph Works, Limited, and W. F. Bishop.
24,100 Ball bearing for axle bearings and for wheels with resilient hubs—M. B. Pallavicini.
24,108 Controllers for electric motor—Pickerings, Limited, and J. Fothergill.
24,122 Starting mechanisms for motor car engines—E. Fillettaz.
24,162 Steam generators—Soc. J. et A. Niclausse.

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24,180 Radial steam or gas turbines—Aktiebolaget Ljungströms Angturbin.
24,195 Wind screens for tramcars, etc.—T. H. S. Palfree.
24,219 Anti-splash guards for motor-driven vehicles T. H. Hutchins.
24,234 Vehicle wheels—A. H. Greenfield.
24,243 Apparatus for signalling on and controlling railway trains in motion E. C. Irving.
24,254 Mechanical signalling apparatus—J. A. Thorne and S. Tulip.
24,282 Signalling apparatus for motor-driven vehicles—G. E. Davis.
24,293 Electric starters for use on motor cars—A. H Midgley and C. A. Vandervell.
24,338 Switch gear for electric distributing systems J. F. Watson and Callender's Cable and Construction Company, Limited.

Specifications Published.

1913.

20,491 Automobile transmission—MacKenzie (*Ford Motor Company*).
25,245 Railway signalling apparatus Hall.
25,350 Train control systems—Kerr.
25,518 Train control—Cortez-Leigh and Parkinson.
25,973 Reversible seats for railway carriages—McLaren
26,009 Cooling apparatus for motor car engines—Russling.
26,350 Change-speed gearing for power-propelled vehicles—Royce and Rolls-Royce, Limited.
26,619 Apparatus communicating signals to trains whilst running—Sullivan and Hughes.
28,341 Brakes and actuating mechanism for the wheels of motor-driven vehicles—James and Robertson.
21,203 Hoods or coverings for motor omnibuses—Marks (*Adler*).
25,636 Means for automatically controlling railway trains—Peck.
25,917 Engines for traction on centre rail railways—Fell and Tindall.
26,243 Suspension of motor road vehicles—Wynne.
26,489 Railway ties or sleepers—Brown (*Gorrell*).
27,249 Electric switches for train lighting—J. Stone and Company, and Darker.
27,366 Apparatus for actuating signals on trains and for stopping trains independently of drivers—Biddle.
27,755 Mechanical stokers—Babcock and Wilcox, Limited, and Davy.
29,298 Signalling devices for railways—Probert.

1914.

7,411 Safety fenders for vehicles—Loscalzo.
10,273 Automatic car and train pipe couplings—Tomlinson.
11,538 Wheel fenders for railroad trucks—Forrester (*Gates*).
14,895 Axle boxes—Beadman and Macklin.
4,171 Fluid-pressure operated brakes—Alley.
14,342 Combined insulating and fastening device for rails—Gorrell.
10,159 Railway chair keys—Thomas and Thomas.
10,892 Automatic car couplings—Stark.
11,947 Crank axles for locomotives—Matthews.
12,733 Railway rolling stock—Babson and Pittee.
17,465 Control systems for electric motors—Storer.
18,732 Wheel for tramway cars—Baxter.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1913. WEEKS ENDED. Dec. 6.	Dec. 13.	Dec. 20.	Dec. 27.	1914. WEEKS ENDED. Dec. 5.	Dec. 12.	Dec. 19.	Dec. 26.	AGGREGATE. Wks.	1914.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	58.300	64.356	61,918	59,432	52,716	52.112	51,634	52,765	51	2,740.729	−108.326
Auckland	...	(28 days) 17,651	...	...	...	(28 days) 20,414	...	...	24½	124.932	+ 15.027
Calcutta ... ... Rs.	68,560	65,644	67,406	70,774	63,057	62,189	62,547	62,574	51	33,91.050	+ 19.652
Madras ... ... Rs.	(2 weeks) 27.079		(2 weeks) 30.800		(2 weeks) 24,471		(2 weeks) 31,416		52	666.621	+ 22.429

Companies Issuing Monthly Statements.

	1913 July.	Aug.	Sept.	Oct.	Nov.	Dec.	1914. July.	Aug.	Sept.	Oct.	Nov.	Dec.	Wks.	AGGREGATE. 1914.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
BrazilianTraction Mlrs	...	...	6,028,078	6,098,850	...	...	...	...	6,096,940	6,241,170	...	...	43	61,411,258	+1,488.593
Brisbane	26,205	29,970	...	27,250	27,053	...	29,680	33,172	...	28,763	28,600	...	47	317,221	+ 30,150
British Columbia $	755,943	770,628	734,283	753,541	746,152	...	690,023	674,812	650,516	661,000	648,485	...	21	3,324,836	− 435,671
Buenos Aires Pt. & C.	...	...	..	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	45,221	...	...	...	...	...	43,327	...	...	...	...	...	4	43,327	− 1,894
Cape Town	...	...	...	12,223	...	...	...	...	...	12,682	...	...	17	49,456	+ 2,953
Carthagena& Herrerias	3,794	2,192	1,344	1,582	1,922	2,698	1,567	2,758	2,175	1,543	1,379	1,255	52	25,322	− 5,541
Cordoba	13,629	13,691	13,343	13,278	...	...	14,256	13,371	12,384	12,919	...	...	30	94,886	+ 883
East India	1,892	2,005	2,028	1,878	1,922	2,046	1,966	2,112	1,980	2,007	2,029	1,839	21	9,967	+ 88
Kalgoorlie	2,796	3,357	3,068	...	...	...	2,552	3,042	2,864	...	...	...	38	23,980	− 2,467
La Plata	4,770	...	4,528	4,920	5,409	5,505	4,359	...	4,190	4,540	4,540	4,452	52	55,384	− 5,961
Lima	34,426	33,939	34,177	35,175	33,236	...	34,600	29,800	28,786	30,648	29,749	...	47	360,869	− 8,224
Manila ... ... $	...	...	138,000	148,000	154,950	...	...	...	116,300	125,750	129,000	...	47	1,470,694	− 77,056
Melbourne	...	...	61,969	65,000	...	...	...	...	58,664	63,328	...	...	43	619,714	+ 23,721
Mexico ... ... $	...	635,445	604,744	616,007	605,467	...	...	687,593	667,421	558,990	643,961	...	47	6,716,716	+ 378,911
Montevideo	...	...	...	...	30,531	33,310	...	...	...	...	27,081	28,605	9	55,686	− 8,154
Port Elizabeth ...	...	...	...	3,553	...	...	...	...	...	3,372	...	...	17	12,522	− 538
Puebla ... ... $	56,700	52,900	51,100	63,000	...	...	51,000	50,500	52,200	49,100	...	...	43	583,600	+ 4,900
Rangoon	...	...	5,054	5,963	5,686	5,424	...	...	4,119	4,600	4,405	4,459	52	59,521	− 3,188
Toronto ... ... $	811,966	850,222	865,796	861,235	849,279	...	866,221	850,639	879,321	849,636	824,634	...	47	9,296,377	+ 402,393
Winnipeg ... $	336,821	340,507	331,732	357,313	360,082	...	346,630	322,762	310,996	330,562	330,398	...	47	3,732,901	+ 34,070

(Continued on page 44)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1913. WEEKS ENDED.				1914. WEEKS ENDED.				AGGREGATE.		
	Dec. 6.	Dec. 13.	Dec. 20.	Dec. 27.	Dec. 5.	Dec. 12.	Dec. 19.	Dec. 26.	Wks.	1914.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1,558	1,416	1,459	1,499	1,551	1,610	1,517	1,551	30	50,036	+ 1,134
Accrington Corporation	559	550	572	633	464	464	447	...	37	20,084	- 1,436
Ayr Corporation	239	235	235	244	227	218	220	220	32	12,152	- 1,040
Bath Electric	748	741	721	730	705	720	699	748	51	48,384	- 50
Birkenhead Corporation	1,206	1,259	1,295	1,330	1,251	1,219	1,264	1,255	38½	48,921	- 1,720
Birmingham Corporation	12,595	12,526	12,777	13,221	12,386	12,216	12,759	12,593	39	472,046	+ 9,705
Blackburn Corporation	1,172	1,185	1,169	1,398	1,048	979	1,036	1,061	39	49,978	- 1,394
Blackpool and Fleetwood	...	...	291	333	...	...	270	355	51	39,018	- 5,018
Blackpool Corporation	644	467	459	595	666	572	540	649	39	66,487	- 9,624
Bolton Corporation	2,581	2,710	2,571	2,828	2,396	2,415	2,441	2,725	39	105,551	- 1,519
Bournemouth Corporation	1,616	1,626	1,790	1,681	1,643	1,741	1,849	1,867	39	80,171	- 2,580
Bradford Corporation	5,586	5,994	5,853	6,268	5,538	5,933	5,667	6,258	39	241,093	+ 9,044
Brighton Corporation	829	821	830	1,019	833	812	830	914	38½	43,530	+ 564
Bristol	7,517	6,923	7,396	9,346	8,460	7,920	8,461	9,715	51½	440,080	+ 26,590
Burnley Corporation	1,566	1,633	1,546	2,024	1,336	1,303	1,352	1,656	39	59,831	- 7,099
Burton-on-Trent Corporation	280	292	287	336	286	264	271	308	39	11,615	+ 171
Bury Corporation	1,290	1,255	1,251	1,427	1,128	1,126	1,133	1,295	38½	52,915	- 150
Cardiff Corporation	2,652	2,631	2,605	2,942	2,483	2,418	2,565	2,676	38	106,599	- 668
Chatham and District	867	850	872	940	974	987	971	1,086	51	49,470	+ 2,017
Chesterfield Corporation	257	248	251	300	256	243	242	308	38	10,362	+ 305
Colne Corporation	251	239	241	292	194	192	200	232	—	—	—
Cork Electric	480	474	445	514	450	424	450	530	51	25,467	- 172
Croydon Corporation	1,566	1,541	1,635	1,094	1,528	1,564	1,627	1,875	38	66,422	+ 1,945
Darlington Corporation	238	231	248	283	257	244	250	264	39	10,268	+ 498
Derby Corporation	923	899	963	1,052	910	900	942	989	38½	39,220	+ 637
Dover Corporation	180	182	192	210	220	229	229	238	39	9,973	+ 114
Dublin and Lucan	120	118	121	267	121	106	114	283	26	3,809	- 32
Dublin United	4,955	5,161	5,298	5,582	5,718	5,495	5,850	6,375	51	300,926	+ 20,380
Dundee City	1,306	1,208	1,266	1,345	1,223	1,238	1,215	1,244	31½	40,999	- 838
East Ham Corporation	1,037	994	1,037	1,149	1,221	1,200	1,237	1,311	38½	45,930	+ 6,426
Exeter Corporation	304	300	302	344	318	306	316	337	39	13,801	+ 222
Gearless Motor 'Buses	...	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	20,759	20,643	20,879	21,061	19,904	20,147	20,093	20,257	29	604,333	- 2,893
Glossop (Urban Elec. Supply Co.)	116	118	115	138	93	96	100	113	52	6,194	- 513
Halifax Corporation	1,960	1,840	1,865	2,001	1,942	1,851	1,831	1,982	38	84,192	+ 2,725
Hastings and District	750	704	752	790	683	724	757	784	52	51,004	- 3,077
Huddersfield Corporation	2,020	1,990	2,013	2,479	2,294	2,270	2,281	2,668	39	111,867	+ 9,079
Hull Corporation	3,201	3,120	3,234	3,494	3,001	2,898	3,030	3,095	39	120,625	- 2,414
Ilford U.D. Council	463	420	434	514	587	593	595	655	38	22,201	+ 4,572
Ilkeston Corporation	121	122	145	122	113	111	120	123	39	5,071	- 263
Ipswich Corporation	375	368	420	444	383	384	398	430	39	17,927	- 289
Isle of Thanet	290	294	293	374	262	266	253	307	12	4,127	- 649
Kilmarnock Corporation	165	162	158	174	148	149	144	149	32	5,219	- 483
Lanarkshire	1,821	1,731	1,773	1,762	1,651	1,699	1,673	1,726	51	94,881	+ 6,677
Lancashire United	1,610	1,484	1,529	1,594	1,469	1,443	1,459	1,499	51	82,792	+ 3,189
Leeds City	8,070	5,958	3,730	8,524	7,919	8,015	8,003	8,715	39	321,584	+ 6,069
Leicester Corporation	2,771	2,729	2,835	3,086	2,785	2,798	2,872	2,935	52	147,514	+ 2,136
Leith Corporation	646	638	642	668	648	653	626	668	32	23,203	+ 199
Leyton U. D. Council	1,337	1,311	1,358	1,495	1,377	1,384	1,323	1,587	37	52,666	+ 2,224
Liverpool Corporation	12,881	13,091	13,416	14,096	12,642	12,446	12,907	13,225	51½	674,276	+ 5,991
Llandudno and Colwyn Bay	108	144	142	175	93	157	159	179	3	495	+ 34
London County Council	42,479	42,752	43,151	46,553	45,553	46,236	36,760	47,992	38	1,690,049	+ 72,939
London General Omnibus	...	...	...	...	...	...	...	...	—	—	—
London United	...	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	184	160	199	195	179	170	165	167	12	2,212	- 220
Maidstone Corporation	183	170	171	213	160	162	161	205	39	8,191	+ 104
Manchester Corporation	17,363	17,617	17,679	17,114	16,351	16,442	17,062	16,568	39	670,242	- 14,303
Metro. Electric Tramways	...	...	...	...	...	...	...	...	—	—	—
National Steam Car	3,580	4,041	3,960	4,482	3,424	3,475	3,417	4,135	8	29,536	- 2,270
Nelson Corporation	183	176	191	224	150	136	144	192	38½	7,231	- 995
Newcastle-on-Tyne Corporation	4,941	4,971	5,195	5,543	5,814	5,624	5,864	6,307	39	213,847	+ 22,214
Newport (Mon.) Corporation	760	756	744	903	743	737	737	734	39	31,705	+ 1,481
New St. Helens and District	777	769	736	853	810	854	836	869	25	23,717	+ 2,187
Northampton Corporation	536	515	532	623	609	564	595	624	38½	23,117	+ 509
Nottingham Corporation	3,311	3,256	3,186	3,176	3,180	3,114	3,175	3,644	38½	130,731	+ 1,085
Oldham Corporation	2,152	2,163	2,178	2,432	1,915	1,938	1,949	2,246	40	87,070	- 1,744
Portsmouth Corporation	1,919	1,957	1,958	1,925	2,042	2,003	2,089	1,905	39	93,875	—
Preston Corporation	852	823	818	952	851	839	806	916	39	35,528	+ 845
Provincial	1,644	1,703	1,769	1,941	1,873	1,773	1,840	2,025	12½	24,056	+ 2,325
Reading Corporation	653	662	660	803	654	656	671	815	38	27,377	+ 332
Rochdale Corporation	1,457	1,472	1,505	1,781	1,401	1,400	1,447	1,714	39	63,037	- 35
Rhondda Tramways	1,182	1,169	1,175	...	1,104	1,067	1,100	...	50	61,220	+ 648
Rotherham Corporation	958	1,004	1,150	1,172	945	948	971	1,219	39	40,505	+ 727
Salford Corporation	5,142	5,261	5,055	5,156	4,581	4,627	4,757	4,761	38	194,602	- 10,096
Sheffield Corporation	7,485	7,687	7,614	8,484	7,676	7,779	8,058	8,609	39½	306,888	+ 7,491
Southampton Corporation	1,233	1,200	1,181	1,445	1,209	1,235	1,239	1,363	38	51,370	- 337
Southend-on-Sea Corporation	674	650	662	817	624	617	616	695	39	39,982	+ 1,926
South Metro. Tramways	...	...	...	...	...	...	...	...	—	—	—
South Shields Corporation	663	653	715	809	696	665	698	773	38½	29,697	- 1,578
Sunderland Corporation	1,332	1,344	1,398	1,592	1,357	1,314	1,366	1,553	39	57,598	+ 815
Swindon Corporation	153	157	150	202	171	168	173	192	38	6,907	+ 480
Torquay Tramways	402	382	389	407	358	345	371	415	51	27,935	- 3,811
Tramways (M.E.T.) Omnibus Co.	...	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	470	446	476	536	515	517	492	533	26	15,589	+ 2,126
Wallasey Corporation	1,098	1,089	1,009	1,171	1,073	1,033	1,066	1,087	38½	48,988	+ 927
Walsall Corporation	628	630	634	898	673	652	679	798	52	32,831	+ 157
Walthamstow U.D. Council	701	692	714	900	726	722	735	775	39	31,684	+ 2,469
Warrington Corporation	438	447	436	460	438	434	439	515	38	16,801	- 414
West Ham Corporation	2,695	2,649	2,694	3,061	2,721	2,793	2,777	3,214	38	109,139	+ 3,946
Wigan Corporation	1,516	1,460	1,488	1,693	1,398	1,349	1,409	1,680	38	56,042	- 1,730
Wolverhampton Corporation	1,045	1,069	1,290	1,167	1,006	1,022	1,151	1,158	40	41,685	- 1,413
Yorkshire (West Riding)	1,333	1,293	1,240	1,846	1,316	1,312	1,325	1,728	52	75,275	- 59

ELECTRIC RAILWAY TRAFFIC RETURNS.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officials and the principal particulars relating to each undertaking.

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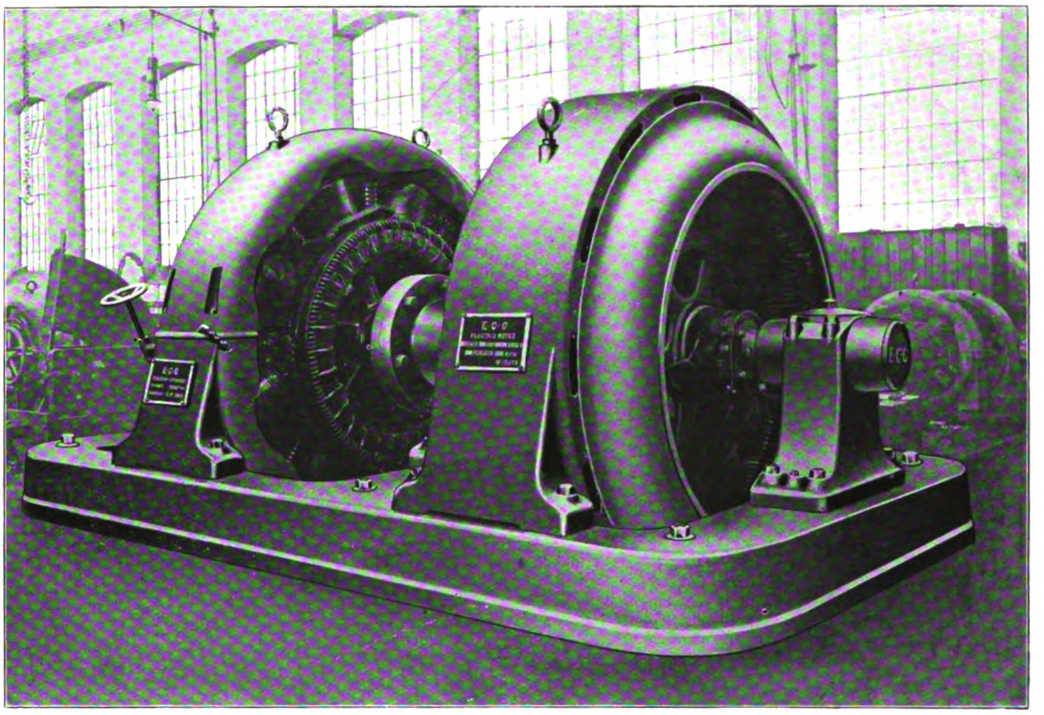

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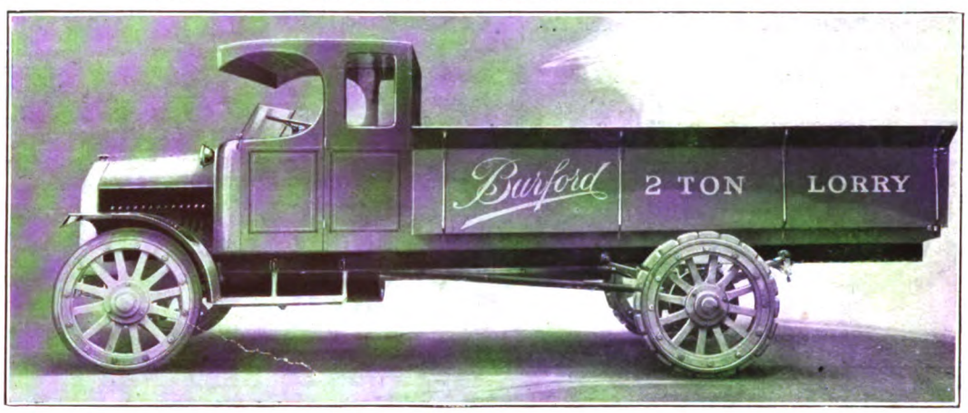

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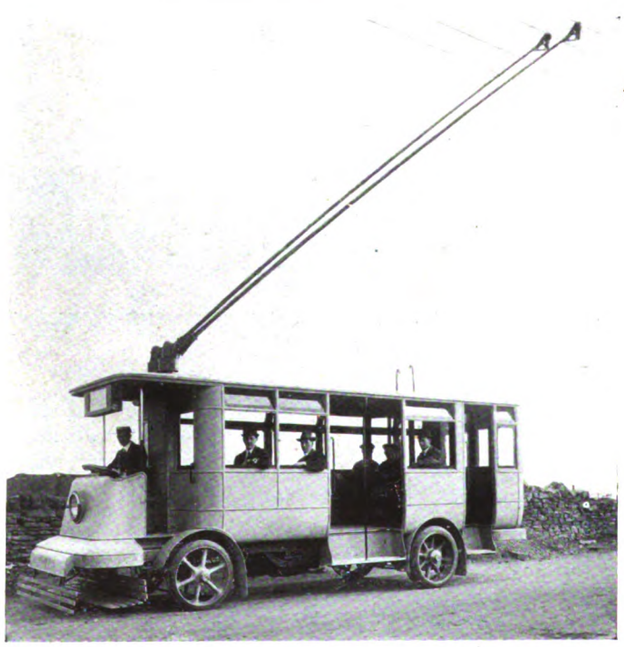

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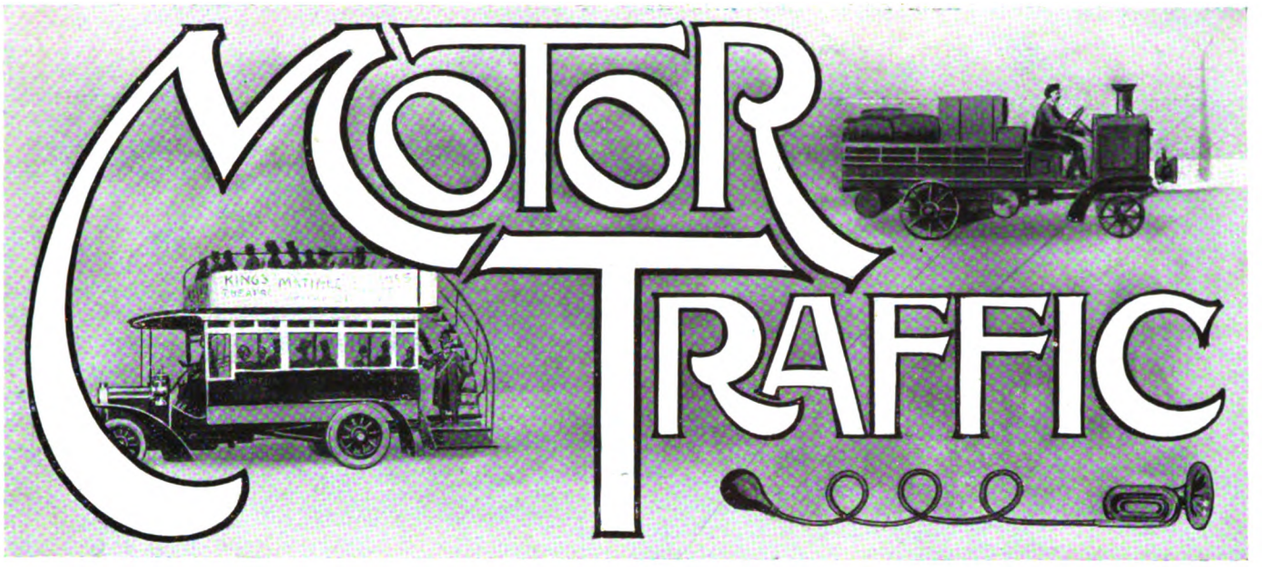

The great reliability trial of motor vehicles which is now proceeding in all portions of the European theatre of war is proving—if proof were still needed—how closely good roads are connected with the satisfactory use of motor vehicles. In too many districts, each of these developments has waited upon the other. In Russia, for example, comparatively very few motor vehicles have been employed for civilian work, owing to the generally bad condition of the roads. On the other hand, it has not seemed necessary to those responsible to improve the roads materially until the motor movement had developed to much greater dimensions. Perhaps the enormous strategical value of good roads had not been fully realised. We know that in spite of the huge number of men available, Russia is in a sense fighting at a disadvantage, owing to her comparative inability to concentrate rapidly in the decisive direction. She was—and still is—badly equipped as regards both railways and roads. Had she been well supplied with the latter, she would still, even though lacking in the former, have been far better able to withstand the rapid concentrations which the Germans, with their splendid network of railways and roads, are able to effect. If even the local rulers of the cities and of the more populated districts of Russia had fully grasped the essentials of the problem, our eastern ally would not have been, as she was, almost wholly dependent from the very first upon such motor transport as could be obtained from England, America, and elsewhere. A national system of good roads must almost always result, in the first instance, from progressive measures taken by municipalities. Each city will form a nucleus of a gradually extending road system, and all the local systems thus created will in time link up and form a national system. The original energy must come from the big centres of population.

* * * *

Very much the same argument holds good as regards the development of motor transport. The official Eye-witness at the front tells us with reference to the British Expeditionary Force that "the troops are fed as no army in the field has been fed before." It is a very open question whether any such claim could have been made if London had never permitted the motor omnibus to be given a fair, and perhaps even an over-generous, trial. Again, it would be difficult to assess to how great a degree the French armies have been dependent on motor transport, and particularly on the fleet of about 1,100 motor omnibuses requisitioned from the Paris General Omnibus Company. Our neighbours recognised the potentialities of these vehicles some years ago, and, when the old double-decked canopy-type was superseded by the present single-deckers, various features of design and arrangement were stipulated in the interests of the military authorities. Incidentally, it may be mentioned that these vehicles—the majority of which are now doing admirable work in the carriage of food stuffs and ammunition—will not be expected to go back into service in Paris when the war ends, but will be replaced by a new and improved type, of which we hope to be able to give particulars before very long.

* * * *

If the Belgian Government could have anticipated events, they would probably some years ago have recognised the wisdom of encouraging, under then existing conditions, the use of road motor vehicles in towns like Brussels, Antwerp, Ghent, and Ostend. British motor omnibuses were instrumental in assisting very greatly the retreat from Antwerp. It would have been better still if the Belgians could have withdrawn and taken with them the whole of their system of local passenger transport. The Belgian roads in many districts have been totally destroyed, and no one can say how much will ultimately be left of their original surface, or whether anything but a skeleton will remain of the system of "Vicinal" railways or tramways which have served to carry interurban passenger traffic. The presence of these railways has encouraged a system of road construction very unfavourable to the general use of motor 'buses or industrial motors. It is quite within the bounds of possibility that when the war is over, the highway system of Belgium will undergo a change, and the Vicinal railways be supplemented by interurban motor omnibus services which, in the aggregate, would be of enormous defensive value.

The efficiency of motor fire-fighting appliances, to say nothing for the moment on the score of economy, has gradually forced itself upon the notice of municipal authorities to such an extent that it is safe to say that the horsed machine is doomed. Already a large number of fire brigades have one or more motor vehicles, and so satisfactory have these been found in service that it is merely a question of time till the whole of their outfit will be brought up-to-date. One of the

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MOTOR TRAFFIC.

most satisfactory features in connection with this progress is the fact that it is not only the large towns and cities that are moving in this direction, but a number of comparatively small communities in rural and urban districts and in small towns are well to the fore in their efforts to equip their fire brigades with the latest and most efficient motor appliances. Naturally in the smaller districts financial difficulties have to be considered, but in view of the fact that the efficiency of the older method is still further reduced by the shortage of horses brought about by the War Office requirements in this direction, we feel convinced that special efforts should be made at once to face the question as there is every probability of the Local Government Board looking with favour upon any reasonable arrangement whereby the safety of life and property can be assured. There can be no question as to the progress on the part of the manufacturers in the development of suitable appliances for the various localities, as each of the leading makers has now standard types which have been specially designed to fill the requirements of the large cities, where a fleet of single purpose machines are necessary, as well as the rural districts, where a single combination machine will afford all the protection to be reasonably expected.

Our belief that the failure of a number of chassis impressed for war service in France and Belgium was due to bad selection on the part of some of the inspecting officers is confirmed by a correspondent whose letter is printed below. This quite clearly proves that unsuitable and worn out chassis have been purchased for the War Department, and, moreover, under such conditions that leaves the transaction open to grave suspicion. The matter is of so much importance, in view of the vital part now being played by motor transport in the war, that we print the letter as received, merely witholding the names. It is unecessary to say that the information upon which our previous comment was based had no connection whatever with this particular case, of which we had no knowledge.

IMPRESSMENT OF WORN OUT CHASSIS.

To the Editor of the Tramway and Railway World.

Sir,—Your remarks in the last issue of The Tramway and Railway World *re* failure of certain vehicles impressed in the early days of the war, we feel are amply justified.

To support your assertions, we know of one machine made early in 1907, sold in 1908, being in constant work on a farm until 1913, then again sold, and later in 1913 taken over by ourselves in part payment for a new chassis. We offered to do this as we were anxious it should be off the road, as being so much out of date it was doing no good to the name of the manufacturer to have it hanging around. Eventually we got it to London, and with regret found it in a worse condition than we expected. Calculating it would cost more to bring it anywhere near present practice than it was worth, we decided to sell it at a break-up price, which we did, obtaining £50 for chassis, tires, and body.

Shortly after the the war broke out, we were requested by the A.S.C. to supply particulars as far as possible of certain chassis, the numbers of which they supplied on their own forms. Our surprise can be well imagined when we found the number of this old chassis included with others of recent manufacture.

We leave you to judge if such stuff ought or ought not to be sold into the Army, when so much may depend upon efficient service, and certainly think there is a screw loose somewhere for such vehicles to be passed for service.

If required we can supply chassis number and the names of the various owners.

INFLUENCE OF MOTOR TRANSPORT ON CONGESTION.

The war affords an admirable example of the influence exerted by motor transport on traffic congestion. It is, of course, of the utmost importance that the lines of communication behind an army should be kept as clear as possible. Owing to its comparatively high speed, and also to the fact that it does not require rest and time to recuperate, the motor convoy is, under many conditions, able to replace four or five horsed convoys of equal load capacity which, under the old system, were often needed to bring up food and other supplies by gradual stages from railhead to the front. In order to arrive at very moderate figures, we will assume the distance not to be very great, and reckon that one motor convoy on the average replaces two horsed convoys of equal load capacity. Now the individual horsed vehicle will not deal with more than about 30 cwt., whereas the motor will take 3-tons. Thus, we replace, say, two horsed convoys of 100 cars each by one motor convoy of 50 cars. A 3-ton motor lorry is shorter than a horsed cart including the animals drawing it. Also, it is under so much better control that the intervals between the various vehicles of a convoy can be safely reduced. On the whole, as an approximation, we may take it then that the introduction of motor transport leads to the occupation of only about one-sixth as much road space as under the old system. Now the speed of the horsed convoy is approximately two-and-a-half miles per hour, whereas the speed of the motor convoy is at least eight, and probably ten miles per hour. Consequently, to get the given load from the railhead up to the front, horsed convoys occupy about four times as long as the motor convoy. To take simple figures, the horsed convoys may occupy three miles of road for 12 hours, whereas the corresponding motor convoy occupies only half a mile of road for three hours.

To get at the relative congestion caused by the two methods, we have to take both space and time into account. Multiplying the two figures together, in the case of the horsed convoy we get $3 \times 12 = 36$. In the case of the motor convoy we get $\frac{1}{2} \times 3 = 1\frac{1}{2}$; and consequently we see that the congestion on the roads behind an army, if horsed carts are used for the supply and transport columns, is, according to this rough estimate, 18 times as great as it would be if motors were employed. The degree of congestion of course in turn exercises a great influence on speed of traffic. If the lines of communication are congested, an advance will often be impeded, and what might have been a victory will merely become a temporary success. Any such congestion is still more dangerous during a retreat, when rapidity of movement may well be the only means of stalling off a decisive defeat, and giving the troops time for rest and for taking up suitable new positions. This estimate, rough as it necessarily is, may help to give some conception of what made possible the great rapidity of the first German advance into France, and still more of how that advance was prevented from developing into a decisive victory, and the success of the Battle of Marne made possible. There is good reason to believe, moreover, that another decisive factor in that battle was the rapid transit of a French army by motors from one side to the other of Paris, threatening the German wing and so compelling a deflection from the original line of advance.

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MOTOR TRAFFIC.

HEAVY MOTOR VEHICLES IN THE WAR.

In an interesting article entitled "This Motor War," which appears in this month's number of *The World's Work*, Mr. Frederick Talbot treats of the various uses to which motor vehicles are being put in connection with the great struggle. The following extracts deal with aspects of the matter likely to be of special interest to our readers.

Mechanical traction is the outstanding feature of the conflict; more and more dependence is being placed upon this method of movement with each succeeding day; greater triumphs are being achieved therewith. It has been described as a motor war, and certainly the description is apt inasmuch as this vehicle is brought into service on every side. It hauls the heavy guns into position; carries troops, commissariat, and ammunition from point to point; supplies motive power for the generation of electricity for lighting and power at stationary depots such as base camps; facilitates conversation through the air by driving the wireless telegraph electric generator; and provides the respective commanders with the most efficient scout yet devised—the airman. All sorts and conditions of self-propelled vehicles are in service. The lumbering petrol lorry thunders along incessantly day and night, carrying troops and ammunition from the base to the firing line, returning with wounded or those fighting men who are in need of a well-earned respite from the trenches.

The triumph of the omnibus as an engine of war has been complete. Its great weight, substantial character of construction, and speed, which the crowded streets of the cities never offered the opportunity to demonstrate, have created considerable astonishment in official circles. The double-deck 'bus appears to meet with the greatest approval, inasmuch as its carrying capacity is much greater than the single-decker such as is peculiar to France.

In the movement of troops this is an important detail. Under pressure the British 'bus has been packed with 60 or more soldiers—there are no passenger regulations upon the battlefield—while a train of such vehicles often stretches for half a mile or more with less than ten feet between each vehicle. And this train tears along when the conditions permit at 30 miles or more per hour—just the maximum speed which the slowest vehicle can knock out in order to preserve the homogeneity of the train and to preserve the "petrol line" intact. In the transport of the wounded also these vehicles have played a very prominent part. They offer a means of getting the men away from the firing line to the base hospital in the shortest time, performing a similar function between the base hospital and the railway centre, whereby the men are despatched home or to other hospitals at remote distances.

But the motor vehicle is only one item in the equipment. The human element plays a very important part, since without it the vehicle is condemned to helplessness. This is where the 'bus driver has scored. At home he has been the target of abuse either because he has splashed the immaculately attired from head to foot in mud, or has declined to pull up dead opposite a waiting passenger in the pouring rain. But out at the front he is a hero, not because he is a crack shot, because he probably knows nothing about a rifle, but because he can tool his vehicle with a coolness and skill which appears to be superhuman. Out at the front he is in his element. He can also let his car go for all it is worth, and although he is acknowledged to be a master of tricks in driving when threading a congested city thoroughfare, he has added considerably to his store of knowledge and skill.

For once the old Juggernaut is permitted to show her turn of speed. Accordingly driving in the Army Motor Transport Service has been promptly dubbed "joy-riding." And it must be confessed that according to reports the London 'bus driver is not permitting the opportunity to escape. An officer who has been invalided home related to the writer that one day he saw the 'bus transport on the *move*. Never before had he realised the speed possibility of the vehicle. A train of them were *en route* for the front, each crowded with soldiers. The leader was a "go-er," and he was coming along at an exhilarating 35 miles an hour, the motor going for all it was worth. The soldiers standing beside the road were astonished. The vehicles were swaying and rolling in the most alarming manner, and an accident was momentarily expected. When the 'buses drew up to the camp a stop was necessary, and the manner in which the brakes were applied threatened a dire smash. There was an ear-splitting grinding and snarling: the wheels being locked, skidded, and the vehicles one and all evinced the disposition to waltz. Yet the vehicles did not overshoot the mark, and there were no rear-on collisions.

But the most amazing sight was the manner in which corners were turned at high speed. As the bend was approached the driver lifted the clutch, allowing the acquired momentum to carry the vehicle forward. With a sharp twist of the steering wheel the nose of the 'bus was swung round, the rear at first showing a marked disinclination to answer such a sharp turn of the helm. There was a lateral skid of three or four feet, the soldiers on top leaned towards the inside of the curve and the incident was over, the vehicle picking up rapidly as the clutch was let in.

The heavy lorry is employed for what may be termed the roughest and heaviest work, such as the conveyance of bulky and weighty supplies for the guns, fodder for the horses, and so forth. Not that it cannot show an envious turn of speed at times when the necessity arises, such as the carriage of troops to the firing line. But its element is not so much the latter as the former.

The British motor vehicles have easily established their supremacy. Solidity and weight tell in the field as much with self-propelled vehicles as with guns. The German motor-driven vehicles, while they have performed remarkable achievements, have a brief life for the most part, while breakdowns, according to reports from the other side, have been somewhat conspicuous by their frequency. This fact was realised by our British War Office authorities when they embraced the subject of motor transport. The results of the German trials revealed very strikingly the weakness of the Teuton vehicles. Strength has been sacrificed for lightness under the mistaken impression that the latter property ensured greater mobility.

Such a desideratum may obtain in cities where the streets are well paved, but in the rigours of war, where the driver has to make the best of what is available, structural weaknesses and defects in material become speedily revealed. It is a significant, though well-known, fact that the average industrial tractor of German design has a useful life of only three years; after that it is fit only for the scrap heap.

There is one explanation for this characteristic. The development and improvement of the motor-driven vehicle has proceeded with such amazing rapidity that three years threatened to become sufficient to render a vehicle out of date and disproportionately expensive to run. Accordingly the German manufacturers, keeping this point in view, fostered the tendency of building their vehicles merely to meet the exigencies of the day; futurity was left to attend to its own requirements. Again it must be borne in mind that the significance of the motor tractor in its relation to industry never has been fully appreciated in Germany, at least not so far as the heaviest forms of traffic are concerned.

The lighter German tractor undoubtedly possesses extreme mobility, which is displayed by the facility and rapidity with which large bodies of troops are moved hither and thither. The excellent roads of the western countries of Europe have contributed to the fulfilment of this urgent military requirement. On the other hand, when the necessity to move heavy and cumbersome loads has arisen, the urgency has been met by the railway or by animal effort.

The wastage in motor material during the war has reached enormous proportions, and this is where the heaviest and most solidly built vehicles establish their value so completely. The lighter vehicles succumb very speedily—they are veritably shaken to pieces under the heavy gruelling to which they are submitted. This is one reason why drivers who are mechanics are in such demand and are able to command such relatively enticing wages. The vehicle is kept on the go day in and day out continuously. The chauffeur has very slender opportunities of overhauling his craft and thus keeping her in the pink of condition. When the opportunity does arrive a solid three or four days' work tightening up and generally overhauling the tractor is inevitable. The light craft is unable to withstand this racket, and unless the materials of construction are of the strongest description the wear and tear is tremendous.

Strange to say, it is not the tires or wheels which occasion the most anxiety, according to those who have the motor transport service in hand, but the mechanism itself. Already the policy of standardisation, accessibility, and simplicity which the military authorities considered to be indispensable in the days of peace are bearing fruit. No other power has been able to keep its motor fleet in such a perfect condition as the British service, for the simple reason that replacements can be effected speedily and with the minimum of effort.

Under hostile artillery fire the question of filling up the gaps in the motor ranks is not a simple matter. But the arrangements completed by the British military authorities, who adequately gauged this factor, enable the British forces to be kept at full strength.

The maximum collective output of the various motor manufacturing shops at home is about 3,000 vehicles per week, which is more than sufficient for the purpose. At the same time the fact must not be overlooked that as the dimensions of the British forces at the front increase, so will the tax upon the motor transport service to keep these increasing numbers well supplied with necessaries and ammunition become more exacting, and it is this provision for any requirement which our authorities have borne in mind.

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MOTOR TRAFFIC.

WHEELS FOR COMMERCIAL MOTORS.*

By Thomas Clarkson.

The wheels of commercial motors up to three tons capacity were formerly made of wood, but for several years wood has given place to steel, and our chief supply of steel wheels has been obtained from Germany, Belgium, and Switzerland. The failure of the German and Belgian supplies has seriously affected the builders of vehicles in this country, and the present is therefore a favourable opportunity for examining the situation thus created, with a view to securing for this country as large a share as possible in the future manufacture of wheels for commercial motors.

The steel wheel hitherto most extensively employed is a casting, and up to the present the British steelfounders appear to have had only qualified success in the production of such castings. A casting is always liable to blowholes and to internal stresses owing to the warring forces of contraction and cohesion, and a good proportion of the ultimate strength of the material in a wheel may be neutralised by internal stresses the existence of which is unknown.

Another difficulty in connection with the use of castings is the inequality of thickness in the material, which causes local variations in the strength, and also results in imperfect balance, which has a deleterious effect upon the life of the tires which are fitted to such wheels.

A few years ago Mr. Morison and the author looked into the question with a view to producing a type of wheel which would be free from the drawbacks of cast material, and which should, as a natural consequence, be both lighter and stronger. The so-called C.-M.

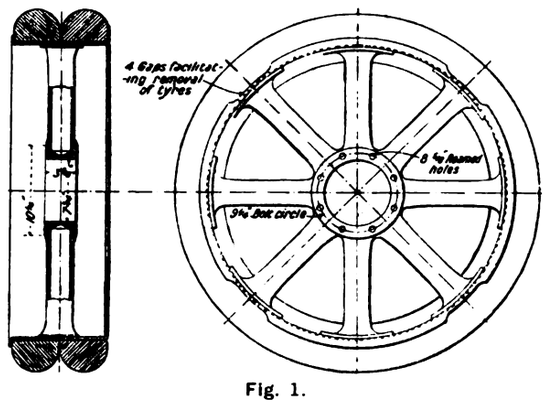

Fig. 1.

Weight on Wheels without Tires.

Size of Tires suitable for Rims.	Weight per Wheel.
760 × 90	122 lb.
860 × 90	130 lb.
1,020 × 90	145 lb.

wheels are the result. These are built up, see Figs. 1 and 1a, and are constructed entirely of forged steel. The spokes are tubular, and are welded electrically under pressure to the hub and also to the rim flanges. The hub, Fig. 2, is a drop forging having bosses corresponding to the spokes, and these are machined to a section which exactly corresponds to the section of the tubular spoke. Butt welding is employed, which has the advantage of preserving the uniformity of the section and avoiding sudden change of section, which is always liable to develop disturbing stresses, resulting in strain and fracture. The rim is pressed up from a steel plate, and the two edges are flanged, one inwardly and the other outwardly, so as to form a stop for the tire. The rims were formerly machined both inside and out, but this is now found to be unnecessary, as the pressing can be done with sufficient accuracy. The spoke flanges are united to the rim either by riveting or by spot welding.

These wheels were first tested on a commercial chassis which was run at high speeds with a 3-ton load, the wheels being fitted with plain steel tires so as to obtain a more severe test than if the wheels were fitted with the usual solid rubber tires. The space intervening between the plain steel tire and the rim of the wheel was fitted in with oak segments, secured to the rim by screws, Fig. 3. These wheels were run under the above conditions at speeds up to 30 miles per hour, until finally the steel tires were hammered out and became slack on the wood blocks.

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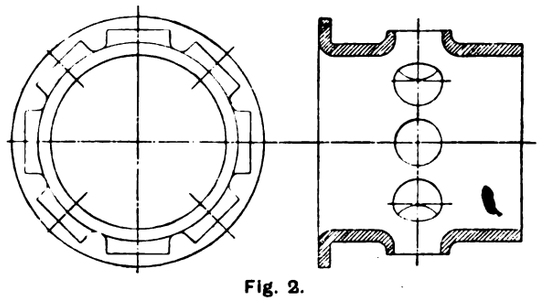

Fig. 2.

Particulars of Tests made (Fig. 4).—As a result of the above tests, permission was accorded to extend the use of these wheels for public service 'buses, and up to the present the distance covered by these wheels has amounted to upwards of 22,000,000 miles.

The leading points of the C.-M. wheel are that, being built up, it is

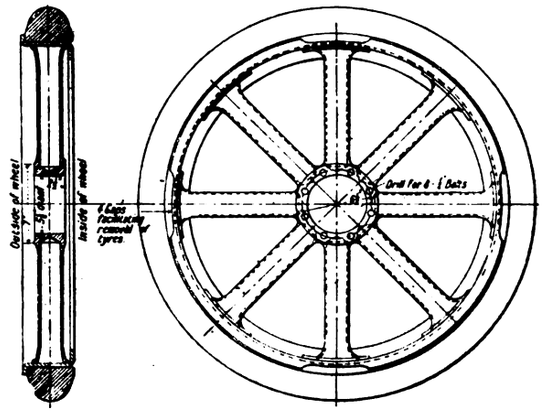

Fig. 1a.

Weight of Wheels without Tires

Size of Tires suitable for Rims.	Weight per Wheel.
800 × 100	76 lb.
870 × 100	80 lb.
960 × 100	92 lb.
900 × 120	100 lb.
920 × 120	92 lb.

free from internal stresses, and as a consequence the whole of the material in the wheel is available to resist useful stress, while there is, of course, no chance of a blow-hole anywhere in the wheel. Next, the material of each part of the wheel and each weld can be tested before the wheel is completed, for which special machinery is provided; and lastly the rim, being pressed out of a plate or rolled, is of practically uniform thickness, and the wheel is in consequence very perfectly balanced.

The chief drawback to the general adoption of this wheel has been the higher cost of production, due to the increased labour charges and the employment of a superior grade of material. The hubs are exceptionally large drop forgings, consequently the dies are costly, and there are very few firms who are equipped with hammers of sufficient power for this class of work. This difficulty is being overcome by a modified construction in which the hub is forged from a circular blank. The blank is first cupped, and on the cylindrical surface formed by the cupping, spoke bosses are pressed out from the centre. This construction results in a material saving in the cost of manufacture. Other economies in manufacture have been effected in various details,

* A paper read before the Institution of Automobile Engineers.

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and also in the installation of a more suitable power plant for operating the welding machines than was at first obtainable, and the author believes that these wheels will soon be produced at a cost which compares favourably with that of cast wheels.

Standardisation.—One cause which has militated in the past, and which still militates, against the cheap production of wheels is the unfortunate variations in design which are so prevalent amongst makers of commercial motors, more particularly in connection with the details of the axle bearings in the wheel hub and the method of attaching the driving gear and the brake drums. During the past year most of the leading makers of commercial motors of from 30 cwt. to five tons' capacity, and also representatives of the War Department have been approached with a view to obtaining standardisation. For the present, the difficulty has been to a large extent overcome by making the wheel hub interchangeable, and of a diameter sufficiently large to accommodate various designs of hub centres. This, to some extent,

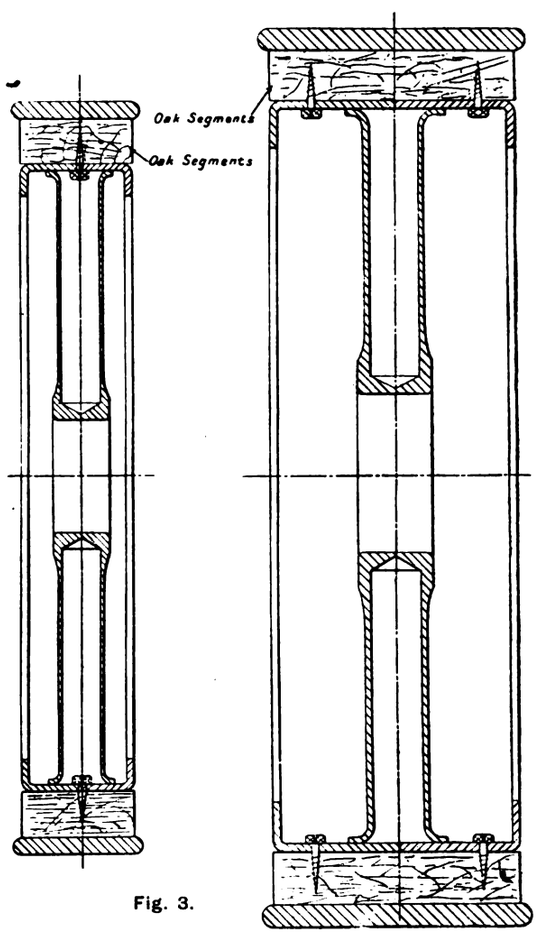

Fig. 3.

obviates the necessity for special construction of hubs, but more remains to be done before the advantages of standardisation are fully realised.

In connection with this the excellent work which is being done by the Engineering Standards Committee, the Society of Motor Manufacturers and Traders, and this Institution must be recognised. They have recommended the adoption as British standards of the following six sizes of rim diameters for solid tires:

670 mm., 720 mm., 741 mm., 771 mm., 850 mm., 881 mm.

In regard to the question of tolerance in rim diameters the Society's Committee has suggested nothing under, but one mm. above, the standard diameter. The author regrets that he is unable to support this suggestion, in the light of his experience. It has not been found practicable to dispense entirely with the use of canvas packing between the tire band and the rim, and the internal diameter of the tire band is frequently under the standard diameter. With a rim above standard diameter there is great danger of bursting the tire band while the tire is being pressed on, and the author is therefore of opinion that for the present it is preferable to make the rim tolerance nothing above, but one mm. below the standard diameter.

Another type of built-up steel wheel which gives excellent results on the lighter class of vehicle is the suspension or wire wheel. It was expected by some leaders in the automobile industry that the wire wheel would be greatly adopted for heavy work and for loads up to three tons, but this anticipation has not so far been realised.

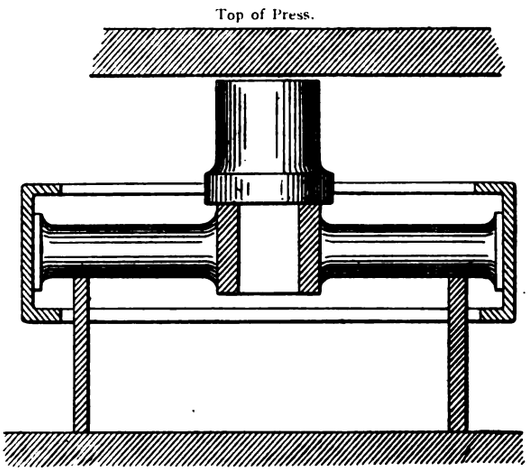

Fig. 4.

Load Tons.	Deflection Rear.	Deflection Front.
1·25	—	0·002 in.
2·5	—	0·010 in.
3·75	—	0·017 in.
5·0	—	0·025 in.
8·75	0·018 in.	—

No permanent set observed at loads given, and neither wheel showed signs of fracture or strain.

The Sankey is another type of built-up wheel in which the two halves are pressed out of a sheet and subsequently united in the centre plane of the wheel by acetylene welding. This makes a very nice-looking job, which appears to stand well when fitted with pneumatic tires,

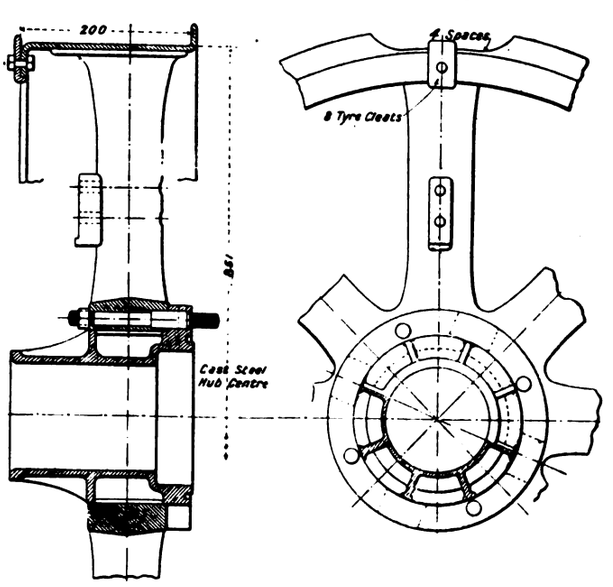

Fig 5.

but the author has not found it satisfactory on solid tires for 'bus work, unless it was reinforced by a centre plate, Fig. 5. This addition makes a material increase in the weight of the wheel, and a further point against it is the higher cost of manufacture.

Plated wheels, both plain and dished, are also used to some extent; these are, of course, well balanced, but are inclined to be heavy, and

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most satisfactory features in connection with this progress is the fact that it is not only the large towns and cities that are moving in this direction, but a number of comparatively small communities in rural and urban districts and in small towns are well to the fore in their efforts to equip their fire brigades with the latest and most efficient motor appliances. Naturally in the smaller districts financial difficulties have to be considered, but in view of the fact that the efficiency of the older method is still further reduced by the shortage of horses brought about by the War Office requirements in this direction, we feel convinced that special efforts should be made at once to face the question as there is every probability of the Local Government Board looking with favour upon any reasonable arrangement whereby the safety of life and property can be assured. There can be no question as to the progress on the part of the manufacturers in the development of suitable appliances for the various localities, as each of the leading makers has now standard types which have been specially designed to fill the requirements of the large cities, where a fleet of single purpose machines are necessary, as well as the rural districts, where a single combination machine will afford all the protection to be reasonably expected.

Our belief that the failure of a number of chassis impressed for war service in France and Belgium was due to bad selection on the part of some of the inspecting officers is confirmed by a correspondent whose letter is printed below. This quite clearly proves that unsuitable and worn out chassis have been purchased for the War Department, and, moreover, under such conditions that leaves the transaction open to grave suspicion. The matter is of so much importance, in view of the vital part now being played by motor transport in the war, that we print the letter as received, merely withholding the names. It is unecessary to say that the information upon which our previous comment was based had no connection whatever with this particular case, of which we had no knowledge.

IMPRESSMENT OF WORN OUT CHASSIS.

To the Editor of the Tramway and Railway World.

Sir,—Your remarks in the last issue of The Tramway and Railway World *re* failure of certain vehicles impressed in the early days of the war, we feel are amply justified.

To support your assertions, we know of one machine made early in 1907, sold in 1908, being in constant work on a farm until 1913, then again sold, and later in 1913 taken over by ourselves in part payment for a new chassis. We offered to do this as we were anxious it should be off the road, as being so much out of date it was doing no good to the name of the manufacturer to have it hanging around. Eventually we got it to London, and with regret found it in a worse condition than we expected. Calculating it would cost more to bring it anywhere near present practice than it was worth, we decided to sell it at a break-up price, which we did, obtaining £50 for chassis, tires, and body.

Shortly after the the war broke out, we were requested by the A.S.C. to supply particulars as far as possible of certain chassis, the numbers of which they supplied on their own forms. Our surprise can be well imagined when we found the number of this old chassis included with others of recent manufacture.

We leave you to judge if such stuff ought or ought not to be sold into the Army, when so much may depend upon efficient service, and certainly think there is a screw loose somewhere for such vehicles to be passed for service.

If required we can supply chassis number and the names of the various owners.

INFLUENCE OF MOTOR TRANSPORT ON CONGESTION.

The war affords an admirable example of the influence exerted by motor transport on traffic congestion. It is, of course, of the utmost importance that the lines of communication behind an army should be kept as clear as possible. Owing to its comparatively high speed, and also to the fact that it does not require rest and time to recuperate, the motor convoy is, under many conditions, able to replace four or five horsed convoys of equal load capacity which, under the old system, were often needed to bring up food and other supplies by gradual stages from railhead to the front. In order to arrive at very moderate figures, we will assume the distance not to be very great, and reckon that one motor convoy on the average replaces two horsed convoys of equal load capacity. Now the individual horsed vehicle will not deal with more than about 30 cwt., whereas the motor will take 3-tons. Thus, we replace, say, two horsed convoys of 100 cars each by one motor convoy of 50 cars. A 3-ton motor lorry is shorter than a horsed cart including the animals drawing it. Also, it is under so much better control that the intervals between the various vehicles of a convoy can be safely reduced. On the whole, as an approximation, we may take it then that the introduction of motor transport leads to the occupation of only about one-sixth as much road space as under the old system. Now the speed of the horsed convoy is approximately two-and-a-half miles per hour, whereas the speed of the motor convoy is at least eight, and probably ten miles per hour. Consequently, to get the given load from the railhead up to the front, horsed convoys occupy about four times as long as the motor convoy. To take simple figures, the horsed convoys may occupy three miles of road for 12 hours, whereas the corresponding motor convoy occupies only half a mile of road for three hours.

To get at the relative congestion caused by the two methods, we have to take both space and time into account. Multiplying the two figures together, in the case of the horsed convoy we get $3 \times 12 = 36$. In the case of the motor convoy we get $\frac{1}{2} \times 3 = 1\frac{1}{2}$; and consequently we see that the congestion on the roads behind an army, if horsed carts are used for the supply and transport columns, is, according to this rough estimate, 18 times as great as it would be if motors were employed. The degree of congestion of course in turn exercises a great influence on speed of traffic. If the lines of communication are congested, an advance will often be impeded, and what might have been a victory will merely become a temporary success. Any such congestion is still more dangerous during a retreat, when rapidity of movement may well be the only means of stalling off a decisive defeat, and giving the troops time for rest and for taking up suitable new positions. This estimate, rough as it necessarily is, may help to give some conception of what made possible the great rapidity of the first German advance into France, and still more of how that advance was prevented from developing into a decisive victory, and the success of the Battle of Marne made possible. There is good reason to believe, moreover, that another decisive factor in that battle was the rapid transit of a French army by motors from one side to the other of Paris, threatening the German wing and so compelling a deflection from the original line of advance.

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MOTOR TRAFFIC.

HEAVY MOTOR VEHICLES IN THE WAR.

In an interesting article entitled "This Motor War," which appears in this month's number of *The World's Work*, Mr. Frederick Talbot treats of the various uses to which motor vehicles are being put in connection with the great struggle. The following extracts deal with aspects of the matter likely to be of special interest to our readers.

Mechanical traction is the outstanding feature of the conflict; more and more dependence is being placed upon this method of movement with each succeeding day; greater triumphs are being achieved therewith. It has been described as a motor war, and certainly the description is apt inasmuch as this vehicle is brought into service on every side. It hauls the heavy guns into position; carries troops, commissariat, and ammunition from point to point; supplies motive power for the generation of electricity for lighting and power at stationary depots such as base camps; facilitates conversation through the air by driving the wireless telegraph electric generator; and provides the respective commanders with the most efficient scout yet devised—the airman. All sorts and conditions of self-propelled vehicles are in service. The lumbering petrol lorry thunders along incessantly day and night, carrying troops and ammunition from the base to the firing line, returning with wounded or those fighting men who are in need of a well-earned respite from the trenches.

The triumph of the omnibus as an engine of war has been complete. Its great weight, substantial character of construction, and speed, which the crowded streets of the cities never offered the opportunity to demonstrate, have created considerable astonishment in official circles. The double-deck 'bus appears to meet with the greatest approval, inasmuch as its carrying capacity is much greater than the single-decker such as is peculiar to France.

In the movement of troops this is an important detail. Under pressure the British 'bus has been packed with 60 or more soldiers—there are no passenger regulations upon the battlefield—while a train of such vehicles often stretches for half a mile or more with less than ten feet between each vehicle. And this train tears along when the conditions permit at 30 miles or more per hour—just the maximum speed which the slowest vehicle can knock out in order to preserve the homogeneity of the train and to preserve the "petrol line" intact. In the transport of the wounded also these vehicles have played a very prominent part. They offer a means of getting the men away from the firing line to the base hospital in the shortest time, performing a similar function between the base hospital and the railway centre, whereby the men are despatched home or to other hospitals at remote distances.

But the motor vehicle is only one item in the equipment. The human element plays a very important part, since without it the vehicle is condemned to helplessness. This is where the 'bus driver has scored. At home he has been the target of abuse either because he has splashed the immaculately attired from head to foot in mud, or has declined to pull up dead opposite a waiting passenger in the pouring rain. But out at the front he is a hero, not because he is a crack shot, because he probably knows nothing about a rifle, but because he can tool his vehicle with a coolness and skill which appears to be superhuman. Out at the front he is in his element. He can also let his car go for all it is worth, and although he is acknowledged to be a master of tricks in driving when threading a congested city thoroughfare, he has added considerably to his store of knowledge and skill.

For once the old Juggernaut is permitted to show her turn of speed. Accordingly driving in the Army Motor Transport Service has been promptly dubbed "joy-riding." And it must be confessed that according to reports the London 'bus driver is not permitting the opportunity to escape. An officer who has been invalided home related to the writer that one day he saw the 'bus transport on the *move*. Never before had he realised the speed possibility of the vehicle. A train of them were *en route* for the front, each crowded with soldiers. The leader was a "go-er," and he was coming along at an exhilarating 35 miles an hour, the motor going for all it was worth. The soldiers standing beside the road were astonished. The vehicles were swaying and rolling in the most alarming manner, and an accident was momentarily expected. When the 'buses drew up to the camp a stop was necessary, and the manner in which the brakes were applied threatened a dire smash. There was an ear-splitting grinding and snarling: the wheels being locked, skidded, and the vehicles one and all evinced the disposition to waltz. Yet the vehicles did not overshoot the mark, and there were no rear-on collisions.

But the most amazing sight was the manner in which corners were turned at high speed. As the bend was approached the driver lifted the clutch, allowing the acquired momentum to carry the vehicle forward. With a sharp twist of the steering wheel the nose of the 'bus was swung round, the rear at first showing a marked disinclination to answer such a sharp turn of the helm. There was a lateral skid of three or four feet, the soldiers on top leaned towards the inside of the curve and the incident was over, the vehicle picking up rapidly as the clutch was let in.

The heavy lorry is employed for what may be termed the roughest and heaviest work, such as the conveyance of bulky and weighty supplies for the guns, fodder for the horses, and so forth. Not that it cannot show an envious turn of speed at times when the necessity arises, such as the carriage of troops to the firing line. But its element is not so much the latter as the former.

The British motor vehicles have easily established their supremacy. Solidity and weight tell in the field as much with self-propelled vehicles as with guns. The German motor-driven vehicles, while they have performed remarkable achievements, have a brief life for the most part, while breakdowns, according to reports from the other side, have been somewhat conspicuous by their frequency. This fact was realised by our British War Office authorities when they embraced the subject of motor transport. The results of the German trials revealed very strikingly the weakness of the Teuton vehicles. Strength has been sacrificed for lightness under the mistaken impression that the latter property ensured greater mobility.

Such a desideratum may obtain in cities where the streets are well paved, but in the rigours of war, where the driver has to make the best of what is available, structural weaknesses and defects in material become speedily revealed. It is a significant, though well-known, fact that the average industrial tractor of German design has a useful life of only three years; after that it is fit only for the scrap heap.

There is one explanation for this characteristic. The development and improvement of the motor-driven vehicle has proceeded with such amazing rapidity that three years threatened to become sufficient to render a vehicle out of date and disproportionately expensive to run. Accordingly the German manufacturers, keeping this point in view, fostered the tendency of building their vehicles merely to meet the exigencies of the day; futurity was left to attend to its own requirements. Again it must be borne in mind that the significance of the motor tractor in its relation to industry never has been fully appreciated in Germany, at least not so far as the heaviest forms of traffic are concerned.

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Strange to say, it is not the tires or wheels which occasion the most anxiety, according to those who have the motor transport service in hand, but the mechanism itself. Already the policy of standardisation, accessibility, and simplicity which the military authorities considered to be indispensable in the days of peace are bearing fruit. No other power has been able to keep its motor fleet in such a perfect condition as the British service, for the simple reason that replacements can be effected speedily and with the minimum of effort.

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Another difficulty in connection with the use of castings is the inequality of thickness in the material, which causes local variations in the strength, and also results in imperfect balance, which has a deleterious effect upon the life of the tires which are fitted to such wheels.

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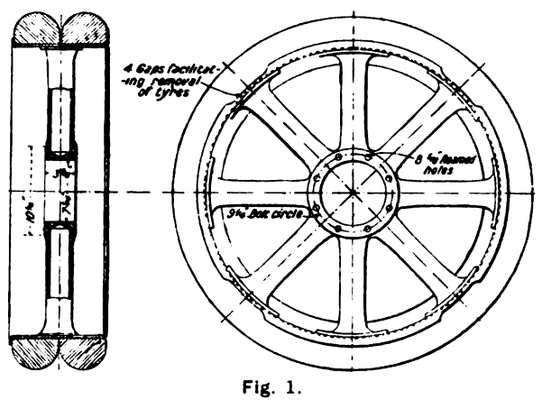

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These wheels were first tested on a commercial chassis which was run at high speeds with a 3-ton load, the wheels being fitted with plain steel tires so as to obtain a more severe test than if the wheels were fitted with the usual solid rubber tires. The space intervening between the plain steel tire and the rim of the wheel was fitted in with oak segments, secured to the rim by screws, Fig. 3. These wheels were run under the above conditions at speeds up to 30 miles per hour, until finally the steel tires were hammered out and became slack on the wood blocks.

Permission was then obtained from the Commissioner of Police to test the wheels on public service 'buses in London, than which the author believes there is no more severe test for a commercial motor vehicle, owing to the exceptional character and conditions of the service. After the trial wheels had run over 20,000 miles, they were subjected to special tests by the engineer of the Chief Commissioner.

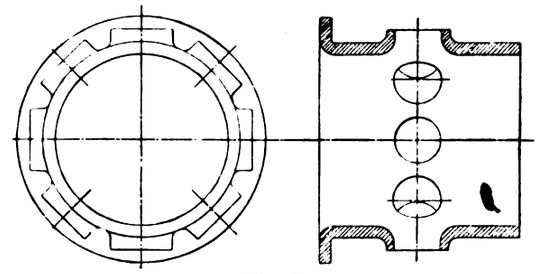

Fig. 2.

Particulars of Tests made (Fig. 4).—As a result of the above tests, permission was accorded to extend the use of these wheels for public service 'buses, and up to the present the distance covered by these wheels has amounted to upwards of 22,000,000 miles.

The leading points of the C.-M. wheel are that, being built up, it is

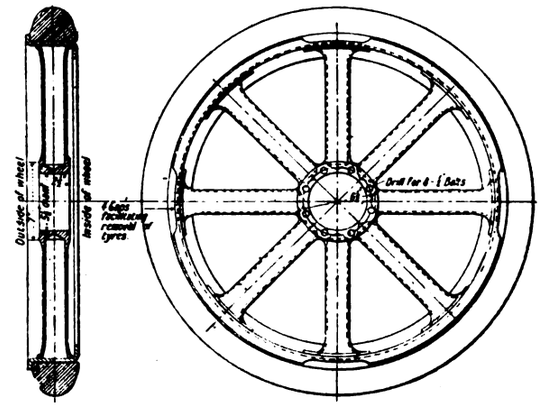

Fig. 1a.

Weight of Wheels without Tires

Size of Tires suitable for Rims.	Weight per Wheel.
800 × 100	76 lb.
870 × 100	80 lb.
960 × 100	92 lb.
900 × 120	100 lb.
920 × 120	92 lb.

free from internal stresses, and as a consequence the whole of the material in the wheel is available to resist useful stress, while there is, of course, no chance of a blow-hole anywhere in the wheel. Next, the material of each part of the wheel and each weld can be tested before the wheel is completed, for which special machinery is provided; and lastly the rim, being pressed out of a plate or rolled, is of practically uniform thickness, and the wheel is in consequence very perfectly balanced.

The chief drawback to the general adoption of this wheel has been the higher cost of production, due to the increased labour charges and the employment of a superior grade of material. The hubs are exceptionally large drop forgings, consequently the dies are costly, and there are very few firms who are equipped with hammers of sufficient power for this class of work. This difficulty is being overcome by a modified construction in which the hub is forged from a circular blank. The blank is first cupped, and on the cylindrical surface formed by the cupping, spoke bosses are pressed out from the centre. This construction results in a material saving in the cost of manufacture. Other economies in manufacture have been effected in various details,

* A paper read before the Institution of Automobile Engineers.

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MOTOR TRAFFIC.

and also in the installation of a more suitable power plant for operating the welding machines than was at first obtainable, and the author believes that these wheels will soon be produced at a cost which compares favourably with that of cast wheels.

Standardisation.—One cause which has militated in the past, and which still militates, against the cheap production of wheels is the unfortunate variations in design which are so prevalent amongst makers of commercial motors, more particularly in connection with the details of the axle bearings in the wheel hub and the method of attaching the driving gear and the brake drums. During the past year most of the leading makers of commercial motors of from 30 cwt. to five tons' capacity, and also representatives of the War Department have been approached with a view to obtaining standardisation. For the present, the difficulty has been to a large extent overcome by making the wheel hub interchangeable, and of a diameter sufficiently large to accommodate various designs of hub centres. This, to some extent,

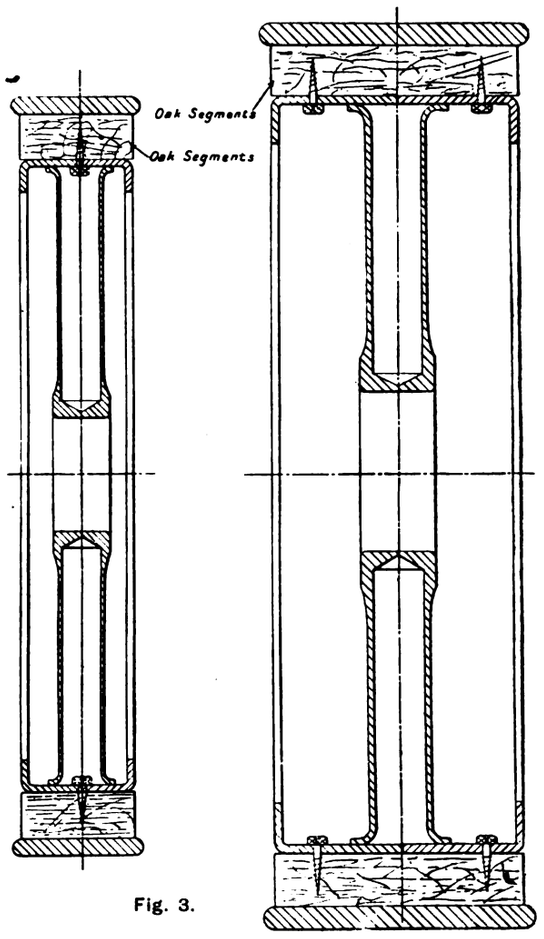

Fig. 3.

obviates the necessity for special construction of hubs, but more remains to be done before the advantages of standardisation are fully realised.

In connection with this the excellent work which is being done by the Engineering Standards Committee, the Society of Motor Manufacturers and Traders, and this Institution must be recognised. They have recommended the adoption as British standards of the following six sizes of rim diameters for solid tires:

670 mm., 720 mm., 741 mm., 771 mm., 850 mm., 881 mm.

In regard to the question of tolerance in rim diameters the Society's Committee has suggested nothing under, but one mm. above, the standard diameter. The author regrets that he is unable to support this suggestion, in the light of his experience. It has not been found practicable to dispense entirely with the use of canvas packing between the tire band and the rim, and the internal diameter of the tire band is frequently under the standard diameter. With a rim above standard diameter there is great danger of bursting the tire band while the tire is being pressed on, and the author is therefore of opinion that for the present it is preferable to make the rim tolerance nothing above, but one mm. below the standard diameter.

Another type of built-up steel wheel which gives excellent results on the lighter class of vehicle is the suspension or wire wheel. It was expected by some leaders in the automobile industry that the wire wheel would be greatly adopted for heavy work and for loads up to three tons, but this anticipation has not so far been realised.

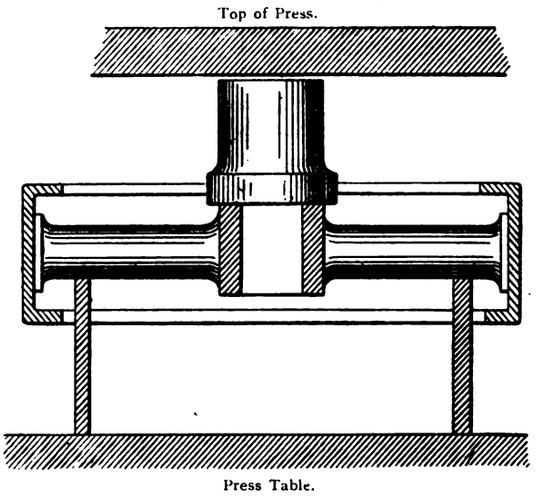

Fig. 4.

Load Tons.	Deflection Rear.	Deflection Front.
1·25	—	0·002 in.
2·5	—	0·010 in.
3·75	—	0·017 in.
5·0	—	0·025 in.
8·75	0·018 in.	—

No permanent set observed at loads given, and neither wheel showed signs of fracture or strain.

The Sankey is another type of built-up wheel in which the two halves are pressed out of a sheet and subsequently united in the centre plane of the wheel by acetylene welding. This makes a very nice-looking job, which appears to stand well when fitted with pneumatic tires,

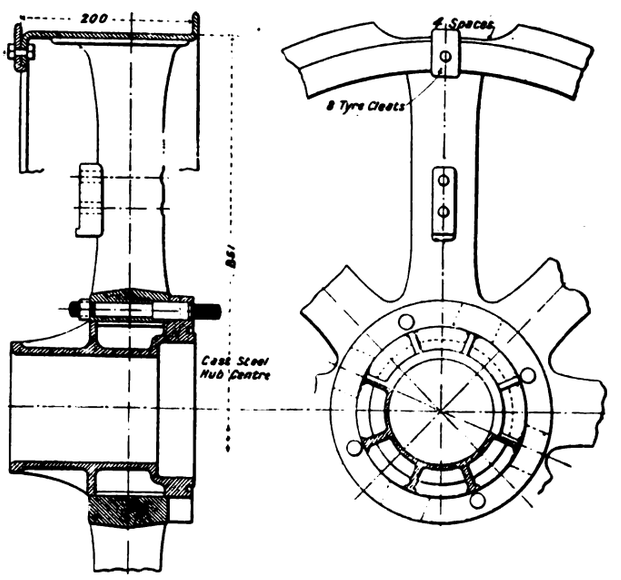

Fig 5.

but the author has not found it satisfactory on solid tires for 'bus work, unless it was reinforced by a centre plate, Fig. 5. This addition makes a material increase in the weight of the wheel, and a further point against it is the higher cost of manufacture.

Plated wheels, both plain and dished, are also used to some extent; these are, of course, well balanced, but are inclined to be heavy, and

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MOTOR TRAFFIC.

difficulty has been experienced in the junction of the plate with the hub, and also, in some cases, with the junction at the rim.

A very good type of plated wheel has been recently put upon the market by Messrs. Ruston, Proctor, and Company, Limited, of Lincoln. In this design, see Fig. 6, two circular plates are dished to a conical

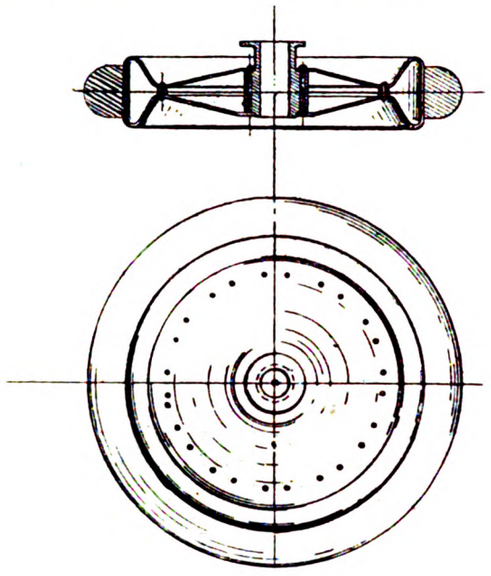

Fig. 6.

section, and the rim is formed by flanging the edge of the plate. The two dishes are united to each other by riveting through distance pieces near the rim, and the plates are joined to the hub by long bolts.

This wheel is superior to other forms of plated wheel in having the rim solid with the plate. The drawback, as with other plated wheels, is that it is about 50 per cent. heavier than is necessary.

The sub-committee of the Engineering Standards Committee expressed the opinion that to facilitate the removal of the tires, four equally spaced slots should be provided in the outer flange of the rim. The Society of Motor Manufacturers and Traders has subsequently recommended that for rims above 771 mm. diameter, six slots should be used. With this recommendation again, the author is unable to agree, experience having shown that four slots are sufficient for forcing off twin tires of 1,050 mm.

As the cutting of the slots necessarily reduces the strength of the rim at these points, it is preferable to arrange that the slots are placed opposite to the spokes, so that the direct support obtained from the spokes may neutralise the loss of strength due to the slotting of the rim flange. The number of rim slots is therefore related to the number of spokes in the wheel. Six spokes are insufficient except for light work, and experience has not shown that it is necessary to employ more than eight spokes even for a load up to five tons. Four rim notches suit an eight spoke wheel, but in order to have six rim notches each separated by a spoke, where more than six spokes are necessary, it is obvious that the wheel would need to be made with 12 spokes—which is more than is required, and adds unnecessarily to the weight of the wheel and the cost of production. Four inches is a convenient width for the rim slots, and it is desirable that the ends of the slots should be radiused instead of having sharp corners. Fig. 7 indicates the preferred construction of rim and rim flange slots.

In regard to the employment of retaining flanges or cleats, the author is convinced that if the tire is properly fitted to the rim and forced on with, say, not less than 50 tons pressure, there is no necessity for a retaining flange or for cleats. Neither the retaining flange nor the cleats will keep the tire on the wheel in the event of a fracture of the steel band forming the base of the tire. For town work the bolts for securing cleats or retaining flanges are frequently sheared by contact with the kerb, and where there is much kerb work the author thinks that it is preferable that no retaining flange or cleats be used, and that the registering flange, against which the tire is pressed, should be put upon the inside; otherwise it is liable to serious injury by contact with the kerb, and the notches in the flange are peculiarly liable to trouble of this kind, and are also liable to catch on the edge of the kerb.

Hub Bearings.—There is considerable diversity of practice in the matter of the hub bearings—ball bearings, roller bearings, and plain bearings are all used. The ball or roller bearing requires less attention for lubrication, but the plain bearing is able to resist shocks with greater impunity. There does not appear to be much to choose in first cost between the ball or roller bearing and a properly-constructed plain bearing. The plain bearing should be provided with hardened-steel surfaces, which are ground accurately to cylindrical shape after hardening. Between the hardened and ground surfaces is fitted a floating bush of bronze or gun-metal, the said bush being drilled - usually spirally—to facilitate the flow of lubricant between the two surfaces.

The plain bearing needs to be regularly replenished with lubricant or it will soon depreciate. The ball or roller bearing requires practically no additional lubrication after the first assembly, but it must be kept clean and dry, or it will rapidly deteriorate.

The critical time for ball or roller bearings is when changing wheels, say, for tire renewals, as it is then that they are exposed, and if, as sometimes happens, part of the bearing slips out of the hub, and on to a wet and dirty floor, and is replaced without first being thoroughly cleansed, depreciation is very rapid, and serious injury to the bearing will result. The presence of water is particularly objectionable in either ball or roller bearings, owing to the corrosion which is set up destroying the surface of the races, and the rollers or balls.

On the whole, the author is of opinion that the best results are obtained by the employment of roller bearings, one on each s de of the hub, so constructed that the bearings are not exposed when the wheel is taken off, and that every part of the bearing is securely held together, so that no part can fall out during the handling of the wheel. Standard designs of hubs are being developed on these lines.

Side Thrusts.—Ball journal bearings are also able to bear considerable side thrust, but in the case of a roller bearing side thrust must be

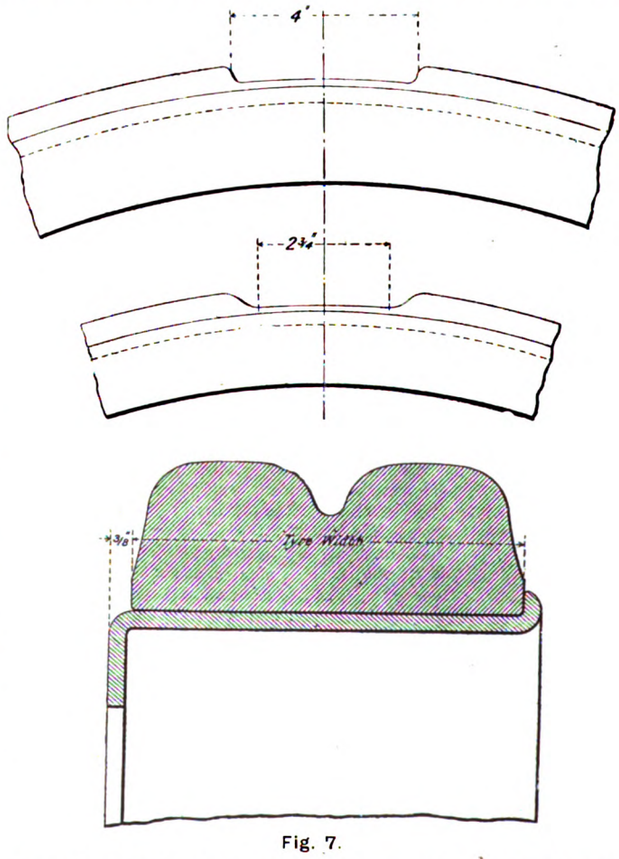

Fig. 7.

provided for independently, either by the use of plain washers or preferably by the employment of properly designed ball thrust bearings.

The practice in the United States is generally in favour of the employment of cone roller bearings in wheel hubs, of the Timken or other somewhat similar patterns. They have the advantage of taking both journal and end pressure, and are, of course, adjustable.

The author is informed that these bearings are not interchangeable owing to a ridge which forms by wear either on the cone rollers or on the edge of the roller race. For absolute interchangeability it is probable that nothing is superior to the plain bearing.

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MOTOR TRAFFIC.

The Employment of Rubber-Tired Wheels on Soft Ground.—A rubber-tired wheel, being designed for use on a hard road surface, is at a disadvantage on soft ground or in snow. The surface of the tire has no tractive "bite," and the rotation of the driving wheels causes them to sink deeper into soft ground. This difficulty is constantly met with in handling the motor transport in France, and is due not merely to bad roads but also to the fact that the vehicles have frequently to be cleared off the roads into adjacent fields so as to facilitate the movement of troops. It is easy to imagine the condition of the fields in consequence of the heavy rains, and the author is informed that vehicles have in some cases been lost through sheer inability to get them back on to the road before the arrival of the enemy.

To overcome this serious difficulty an attachment to driving wheels has been designed by one of our transport officers. This device consists of a series of steel rings which are secured to the periphery of the

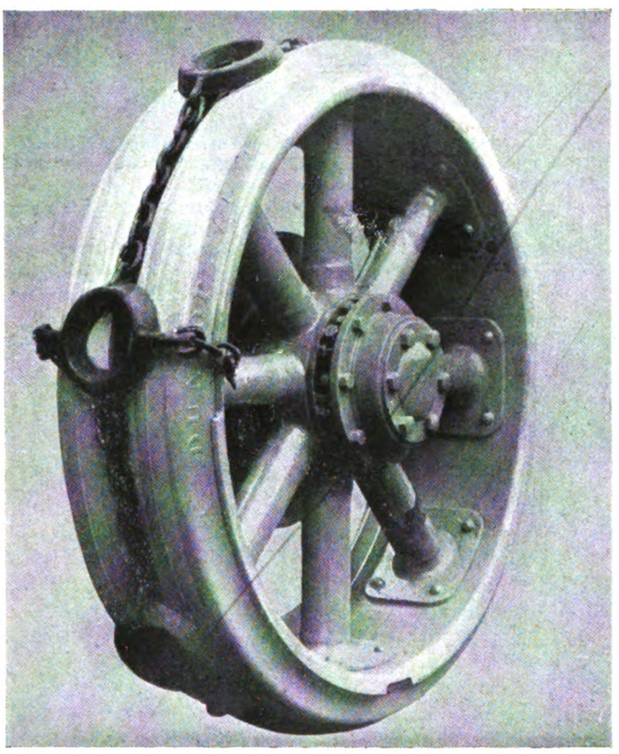


Fig. 8.

driving wheel by a central chain which is provided with turnbuckles. An anchor chain is also provided to prevent circumferential slipping. The device can be quickly attached and detached when required, and its reliability has been demonstrated in actual service; it is not suitable, and is not intended, for use upon a hard road surface. Fig. 8, Plate 1, shows a wheel fitted with this non-skid device, of which some thousands are now in use at the front.

THE WHITE PETROL LORRIES.

The 3-ton and 5-ton White petrol chassis, for which the White-Coleman Motors, Limited, are the sole concessionnaires, are the products of the White Company, of Cleveland, U.S.A., whose reputation for excellence of design and workmanship may be said to be world-wide. In general arrangement the two machines are exactly similar, the actual difference being in the power of the engine and strength of frame. The 3-ton model is fitted with 30-H.P. 4-cylinder engine, $3\frac{3}{4}$ in. bore with $5\frac{1}{8}$ in. stroke, and the 5-ton model with a 40 H.P. engine, $4\frac{1}{4}$ in. bore, and $6\frac{3}{8}$ in. stroke. In each case the four cylinders are cast in one piece, with intake, exhaust, and water passages and manifolds included. All the valves are on one side, while the valve stems and springs are all enclosed by a detachable plate. A compression release for easy starting is also fitted, all working parts being completely enclosed. In the case of the 3-ton chassis the frame is built up of 6 in. by 1 in. steel girder, and in the heavier model 7 in. by 1 in. In both cases the frame is continued round the front in the form of a bumper, thus affording absolute protection to the radiator. It is claimed for this form of construction that it is the strongest possible design for the weight.

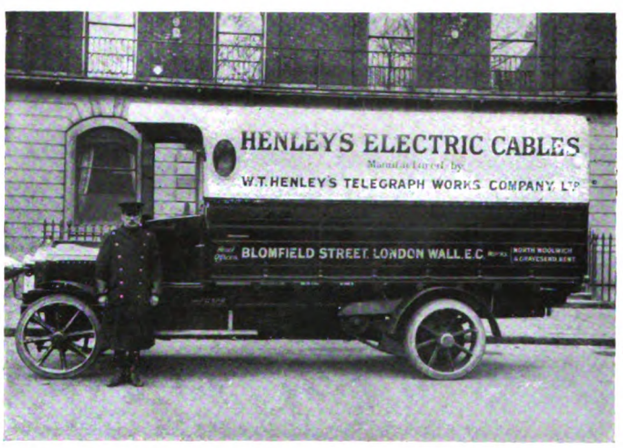
The cooling arrangements include the White improved honeycomb radiator which is supported on shock absorbers which protect it from all jars and strains; a gear-driven centrifugal pump ensures a positive water circulation. There are many points of interest in the White machines which not only appeal to the eye but are of sound practical value, and we shall not be surprised if the demand for both these models is an extensive one.

HENLEY'S SOLID BAND TIRES.

After exhaustive tests, which have clearly demonstrated both their resiliency and durability, Messrs. W. T. Henley's Telegraph Works Company, Limited, of Blomfield Street, E.C., have placed upon the market a complete line of solid band tires which will, we feel certain, be heartily welcomed by all interested who know something of the thoroughness which characterises the methods of manufacture obtaining in the Henley Company's works. The reputation which the firm have built up in their cable and other departments can be taken as a guarantee of excellence both as regards material and workmanship, while the usual guarantee of 10,000 miles ensures that the "life" of the

tires will at least equal that of the best-known makes. It is claimed for the Henley solid tire that the design is scientifically correct, and allows the maximum of resiliency in service by lateral expansion, apart from the natural elasticity of the rubber.

As will be seen by the sectional illustration the moulded rubber tread is mounted upon and permanently united to a hard vulcanised rubber base, curved to increase resiliency and also to prevent lateral displacement, the base being dovetailed inseparably into the steel band. No wires or internal fastenings are embedded in the rubber; therefore



Albion Van Fitted with Henley Solid Tires.

wear can only take place upon the tread. The basis of the tread is Para rubber of the finest quality rendered exceedingly tough by a special process, hard to cut and durable, yet yielding to road shocks and resisting vibration.

The accompanying illustration is of an Albion van fitted with Henley solid band tires. During the tests, which were extended over a lengthy period, this vehicle was fitted with one Henley tire and three of other makes, careful records being kept of the performance of each. By this means Messrs. Henley were able to satisfy themselves as to the wearing qualities of their own tire, which they assure us had a longer life than any other make tried on the van.

In order to handle the rapidly growing tire business the firm have taken extensive premises at 18, New Union Street, Moorfields, to which address all communications to the tire department should be sent.

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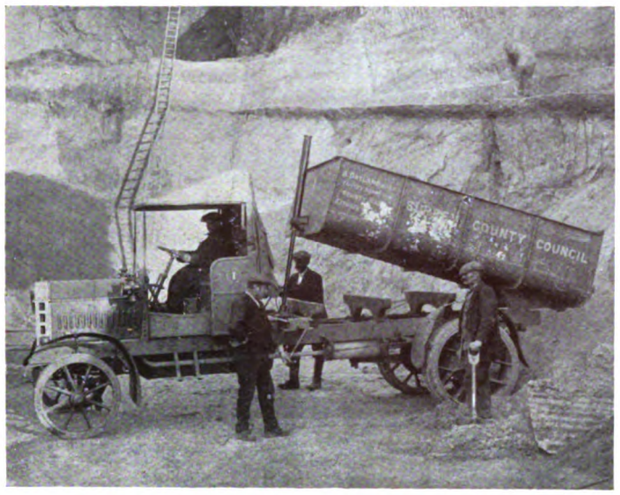
MOTOR TRAFFIC.

THE COMMERCIAL CAR MECHANICAL TIPPER.

Commercial Cars, Limited, of Luton, have for the past two years been making a special feature of tipping wagons for the use of municipalities and building contractors. At the present time some of this type are in use in remote townships of Canada and New Zealand. The tipping mechanism to raise or lower the body, which is usually made of steel and



Mechanical Tipper Van.

has a capacity of six tons, is controlled by a vertical telescopic screw. The screw is operated from the front of the gear box by a case-hardened worm, and special hard phosphor bronze alloy worm wheel, giving a reduction of 2 to 1. This is enclosed in an oil-tight and dust-proof aluminium case The front portion of main shaft of gear box is extended to accommodate the worm, which is provided with a suitable journal and ball thrusts. The worm wheel is mounted on a stiff cross shaft running in plain bearings, which projects through the aluminium gear case on the off side of the car. Lateral movement to the worm wheel shaft operates dog clutches inside the gear case, which throw in and out of gear the tipping mechanism.

Tipper Van for Adelaide.

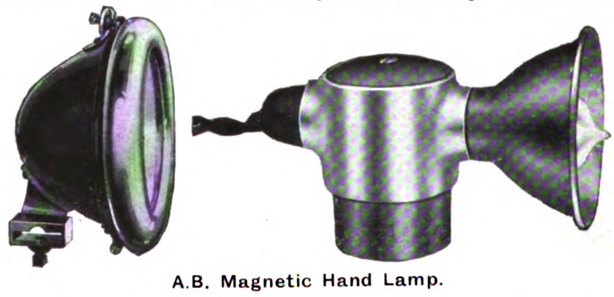
One form of gear is operated from the ground by the side of the driver's seat, which gives the operator an opportunity of watching the distribution of the load; it can also be made to be operated direct from the driver's seat. The end of the worm wheel shaft on the near side is extended and further supported by a bracket, dropped from the frame side members. The shaft is carried through the bracket, and on the end of this shaft is keyed a sprocket wheel, which wheel transmits the drive through a Reynold's roller chain to a transverse shaft, which in turn transmits the drive through dog clutches, giving an up and down movement to the worm screw, through suitable bevel gears. The dog clutch is actuated by substantial striking mechanism through a lever which is placed near the driver's seat.

To lower the tipping wagon, the central dog is pulled in the direction of the off side of the wagon, and to the near side for raising. A mechanical cut-out is fitted, operating direct on to the striking shaft controlling the dog clutches, and is composed of telescopic tubes. These are worked positively from the tipping body, which pulls out the operating dogs, when the body arrives at a pre-determined height, and also throws the dogs out of gear when lowering, that is when the body just rests on the transverse cross bearer, directly behind the driver's seat.

Our illustration of one of these wagons, which has been shipped to the Adelaide Electric Supply Company, Limited, South Australia, shows the body in a raised position, and the operating lever will be noticed at the side of the car. This model is not operated from the driver's seat.

BLACKWELL'S MOTOR CAR ACCESSORIES.

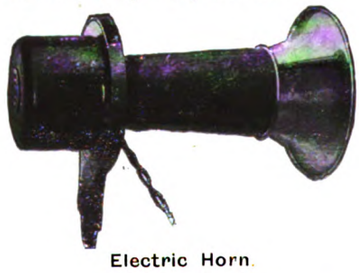
R. W. Blackwell and Company, Ltd., have recently added to their business the supply of accessories for motor cars. These include electric lamps and horns, also gongs of various patterns, all of which are well illustrated in a special catalogue, a copy of which can be obtained upon request. The lamps, which are made in various sizes as head lights, side lights, dash lights, and tail lights, have pressed-steel bodies, stove enamelled and polished, the reflectors being made of spun brass, heavily electro-plated with pure silver. It is claimed for these lamps that while they compare favourably in appearance with any other make, they are of such solid construction that they are specially suited for the heavy duty demanded from commercial and public service vehicles. A lamp of exceptional interest included in the catalogue is the A-B magnetic hand lamp. This is a 4-candle-power hand lamp, fitted with a



A.B. Magnetic Hand Lamp.

magnetised base, which enables it to be placed in any position on the chassis frame in order that inspection or repairs can be carried out at night with much greater facility than is possible with an ordinary inspection lamp. This magnetic lamp only weighs 13 oz., but has a pull of 13 lb.

The electric horns are a very decided improvement on the bulb type; they are thoroughly efficient and reliable, and, as in the case of the lamps, are built for hard service. There are no exposed contacts, the whole of the mechanism being totally enclosed.



Electric Horn.

The mechanical gongs include single-stroke gongs, multiple-rotary foot gongs, and fire apparatus gongs, all being made either in vertical or horizontal types. The mechanism is on the most improved lines, embodying few parts and, consequently, are less liable to become disarranged. For commercial vehicles, steam wagons, and all machines without electric batteries, these gongs are designed so give efficient service, and as there are no springs or delicate mechanism to get out of order, they should outlast the vehicle.

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MOTOR TRAFFIC.

MOTOR FIRE ENGINES IN SYDNEY.

An article in a recent issue of *Dalgety's Review*, a magazine published in Sydney, gives an interesting account of the Sydney Metropolitan Fire Brigade. As will be seen from the following extracts, the use of motor fire engines in Sydney is already extensive, and there is little doubt that in a short time the use of horses by the brigade will be abandoned in favour of more modern motors. For the photograph of a Sydney motor engine with its crew ready to start we are indebted to Dennis Brothers, Limited.

In no city is there greater need for an efficient fire extinguishing force than in Sydney, and considerable strides have been made during the past three or four years in equipping the Metropolitan Fire Brigade with modern appliances. The passing of the Fire Brigade Act, and the institution of a Board of Fire Commissioners of New South Wales in the year 1909, opened a new era in fire brigade control. The Commissioners superseded the old Metropolitan Fire Board, and the new board was invested with powers extending over the whole State. All fire brigades are subject to the one board of control, whether the brigade comprises permanent firemen or volunteers.

There is a cool alertness and smart efficiency in the fire brigade that is not met with in most civil government departments. All conflagrations of any magnitude are under the direction of the chief of the brigade or his deputy, but there are small fires that bring out the daring, the

One of a Fleet of Dennis Engines Used by the Sydney Fire Brigade.

skill, the ingenuity and the coolness that go to making chiefs and deputy chiefs in a larger proportion than in most callings. It is probably in consequence of this individual efficiency that so much success attends the efforts of the Metropolitan Fire Brigade. Quickness in response is the very essence of fire fighting success. Formerly it moved from head-quarters in Castlereagh Street, Sydney, with smart horses; now it is with swift motor fire engines, as in the accompanying illustration, which depicts a turn-out from the central station.

The vastness of the organisation may be gauged from the fact that in the metropolitan area there are 26 permanent stations occupied by about 250 permanent firemen, and 24 stations entrusted to 22 permanent and 173 volunteer firemen. Outside the metropolitan area, that is, in the country districts, there are 91 districts requiring 36 permanent firemen and about 1,130 volunteers. Every station does not possess a motor fire engine, but advantage is taken of motor appliances so far as funds will permit of their installation. The motors give greater facilities for transit than horse power, enabling the brigades to cover distance more quickly and to give a quicker response to the call. This substitution of motor for horse-power engines in country districts is doubtless proceeding as far as funds permit. Fires generally outside the metropolitan area do not run a great conflagration risk; but in the city proper this risk is very great, consequently the authorities have taken every opportunity to acquire most modern and efficient fire fighting appliances.

At the present time the 12 motor fire engines in the metropolitan brigade can pump over 5,000 gallons of water per minute on to a fire. With a capacity of over 350,000 gallons of water per hour, to pour on to a fire, or on to surrounding buildings, Superintendent Sparks has at his command an extinguishing force that masters most conflagrations and by which most of the surrounding buildings are saved. To save human life, and also for the purpose of playing on the fire, an electric-driven ladder reaching 85 ft. in height, and two petrol-electric motor ladders reaching 75 to 80 ft. respectively are provided.

For the purpose of receiving information speedily, there are fully 410 telephone fire alarms installed within the metropolitan area; they are situated a quarter of a mile apart in the city, and half a mile in the suburbs. Eighty to 90 per cent. of the calls to fires are received by these means, and the balance direct at head-quarters office from the scenes of the outbreaks. The calls last year eclipsed all previous records, due in a measure to the larger city and increased population. Last year the fire brigade's vehicles covered nearly 51,000 miles in the metropolitan area. Over 51,000 eight-hour watches were kept; more than 46,000 inspections of telephones were made, and over 7,000 inspections of hydrants to test the water supply; nearly 500 inspections of buildings, and almost the same number of inspections of theatres and public halls.

When not engaged at fires or otherwise on duty, drills are given with the ladder, and in the rescue of persons from fire. The ladder that is a fire escape also becomes a water tower, connected with a line of hose from the ground, giving either a horizontal or vertical jet, according to the height of the building or the floor which receives the 300, 400, 500, 600, or 700 gallons of water per minute from the engine. This jet may be manipulated from the ground by lines.

MOTOR VEHICLES AT THE SMITHFIELD CLUB SHOW.

AN INTERESTING DISPLAY.

As was to be expected, the number of exhibits in the motor vehicle section of the Smithfield Club's Show at the Agricultural Hall, was considerably reduced this December by reason of the fact that several of the manufacturers who usually take advantage of this fixture have their output fully taken up by the Government. The Show was open from Monday, December 7, to Friday, December 11, and was the 116th to be held under the auspices of the Smithfield Club. From every point of view it would appear that the decision to hold the Exhibition as usual, notwithstanding the European crisis, was well justified, for while a number of firms usually represented were absent, the whole space available was taken up, and the attendance was well up to the average.

Although a number of internal combustion engines, including petrol, oil, and gas, designed for the driving of various kinds of farm machinery, were shown, mechanical traction was principally represented by the steam vehicle, the majority of the leading manufacturers of this type of machine being represented by some exceptionally fine specimens of the up-to-date steam wagon. Prominent amongst the latter the "Foden" attracted considerable attention. This exhibit was a 5-ton steel-tired machine with an awning over the engine and driver. The general design of the Foden steam wagon is of a novel and original character, simplicity and accessibility being two strong points in its favour. The boiler, which is of the horizontal multitubular type, forms the front part of the framework. The sides of the frame are constructed of strong channel steel tied and braced together in such a manner as to secure great strength in the complete wagon. The boiler, which can be fired with coke, coal, or wood, is claimed to be the easiest steam maker of any boiler extant. The wagon is driven by a compound steam engine mounted on the top of the boiler and working with dry steam. It is fitted with two cylinders, 4 in. and 6¾ in. respectively, having a patented high-pressure gear by means of which both cylinders can, in case of emergency, receive live steam direct from the boiler. Both cylinders exhaust independently into the chimney. The reversing motion is of the ordinary link type, and the whole construction of the engine and steering arrangement is so simple that any ordinary traction engine driver can easily handle the wagon without previous experience. The power is transmitted by a pair of spur wheels acting upon a compensating gear by means of a strong roller chain. This gearing is arranged for two speeds, three and six miles per hour. The wagon is capable of taking a load of five tons on its own platform and three tons on a trailer six miles per hour on ordinary roads and three miles per

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MOTOR TRAFFIC.

hour up a gradient of 1 in 6. For several years the Foden wagon has been most popular with contractors and others engaged in heavy haulage, and many remarkable records have been obtained under varying conditions which clearly demonstrate the economy of the machine. Recently its fame has reached the municipal field, and a number of wagons are now in daily service for municipal and county authorities, having replaced horse traction over which it is claimed to have effected a saving of some 50 per cent.

Another wagon which found favour with visitors was the "Garrett," fitted with an unusually handsome box body. This was staged by Messrs. Richard Garrett and Sons, Limited, of Leiston, and was a further example of the type of superheated steam road vehicles, for which this firm have been consistent advocates.

Messrs. Charles Burrell and Sons, Limited, exhibited a 5-ton tractor, the special feature of which was the double drive. This, the firm claim, has many advantages over other systems, as by distributing the drive over both wheels a substantial reduction in maintenance is obtained.

A 3 ton rubber-tired wagon was exhibited by Messrs. William Allchin, Limited, the special features of which were the exceptionally large boiler and high steam chest, giving a plentiful supply of steam, which is always dry. William Foster, Limited, exhibited a specimen of their standard haulage engine of the Wellington type, while other exhibitors included Mann's Patent Steam Cart and Wagon Company, Limited, the Yorkshire Commercial Motor Company, Wallis and Stevens, Limited, and W. Tasker and Sons, Limited.

NATIONAL STEAM CAR COMPANY.

USE OF COKE FUEL.

The fourth annual meeting of the National Steam Car Company, Limited, was held on December 29 in the Great Eastern Hotel, London.

Mr. Thomas Clarkson (chairman and managing director), who presided, and moved the adoption of the directors' report, said that the results of the year's trading showed a marked improvement upon the position of a year ago. After allowing for depreciation there was a profit of £35,916. Out of this sum provision had to be made for the annual overhaul of the usual proportion of 'buses and for renewals. The sum of £10,005 was allocated in respect of overhauls, which allowed for practically the same expenditure per car as during the past year, although it had lately been found practicable to do the overhauling for a smaller sum. A certain amount had in the past been placed to the account of the depreciation of the 'buses, but as they were constantly maintained in a state of efficiency, the board considered that the word "depreciation" was a misnomer. They had therefore decided to form a special reserve fund for the renewal of the fleet, and to this fund would be added the sum which would otherwise have been allocated to depreciation account. It was proposed to add £15,000 to this special reserve fund, which now reached £28,069, and also to place £3,000 to the general reserve, which would be available for the equalisation of dividends. Of the balance, it was proposed to utilise £7,875 for the payment of a 5 per cent. dividend, leaving £618 to carry forward. The directors had to consider early in the year the provision of further capital for the business. The necessary financial accommodation was provided by the company's bankers, their advance being covered by 75 £1,000 debentures. The whole of this advance had been repaid to the bank. The financial arrangements necessary for the future development of the business were receiving the careful attention of the board. The understanding with other omnibus proprietors had conduced to prevent wasteful competition, and made for public safety. The receipts during the past year had been almost the same per mile as in the preceding year, while the working expenses showed a substantial reduction. After January 1 oil fuel would cost less, and a gradual substitution of coke fuel would effect a further reduction. The war had not adversely affected the company's business. Owing to the requirements of military transport a large number of 'buses had been withdrawn from service in London. This tended to increase the traffic receipts of the 'buses remaining, though on the other hand the indirect expenses per 'bus were greater with a smaller fleet. The military authorities had purchased 30 of the company's omnibus chassis at a price which the directors considered fair and reasonable. Over 100 of their men had joined His Majesty's forces. Their places were, of course, being kept open. In addition to the company's ordinary manufactures at Chelmsford, the works had been employed during the past four months in the manufacture of a non-skid device, which was now being extensively used with the motor transport vehicles at the front. This non-skid appliance enabled the motors to operate successfully on soft ground. The company has been appointed sole manufacturers of the Crawley-Boevey non-skid device, which was the type adopted by the War Department. It was the invention of a British transport officer.

Another result of the war was the stoppage of the supply of steel wheels, which were formerly obtained in large quantities from Germany and Belgium. In consequence, the company had experienced an unprecedented demand for their patent C.M. wheels; in fact, the wheel business offered far exceeded their manufacturing capacity. The directors were taking steps to increase the output of this branch of the business with all possible speed. When he last addressed the shareholders, reference was made to the investigations directed towards the employment of a cheaper fuel. These investigations had now been brought to a successful conclusion. After many experiments, one of their motor omnibuses was adapted to use ordinary gas coke as fuel instead of paraffin, at less than one-third the cost. Between this achievement and the actual running of a 'bus in service with the new fuel a considerable interval was unavoidable, owing to the prolonged tests (both mechanical and chemical) which were conducted by the experts of the Chief Commissioner of Metropolitan Police, in order to satisfy his legitimate requirements that a 'bus using coke fuel should be in every way suitable for service in the streets of London. After such a severe ordeal the coke motor 'bus had been approved for service. One of these 'buses had been running for some time, and a careful observance of its performance under service conditions indicated to him a very important future for this type of motor in passenger service. The suitability of this motor for the economical transport of merchandise had also been kept in view, and at the Whit-Monday parade of the Commercial Motor Users' Association one of the coke motor lorries was exhibited for the first time. For this a silver cup was awarded. Trial orders for coke motor lorries were soon received. A London gas company, after making a lengthy test of one of these motors, had favoured the company with an order for six more. The figures of the remarkably low cost of fuel with the coke motor were regarded by some motor transport experts as too good to be true. In order, therefore, to set this question at rest, the board decided to submit a coke motor to the Expert and Technical Committee of the Royal Automobile Club for the purpose of an official trial and to obtain a certificate of actual performance. The test was carried out during the latter part of July, with the result that the fuel economy recorded at the official trial was over 25 per cent. better than had been previously claimed. About a month ago the secretary of the Royal Automobile Club intimated that the Expert and Technical Committee of the club, having considered all the trials made by the club during the year ended October 15, had selected the company's national motor as the most meritorious performance, and in consequence of this the company were awarded the "Dewar" Trophy. He referred also to the gold medal which was presented by the Institution of Civil Engineers last month for his paper on the engineering work of the company.

Mr. Aylmer Maude seconded the motion, and after some discussion it was agreed to.

GLASGOW TOWER WAGONS.

Halley's Industrial Motors, Limited, have recently received the sixth repeat order for tower wagon chassis from the Glasgow Corporation tramways department, the order being for three 25-H.P. chassis. It is of interest to note that since 1907, prior to which date the tramways department of this Corporation experimented with various makes of chassis for tower wagons, the whole of their purchases of chassis for this purpose have been of the Halley make, and now amount in all with their last purchase to 11 vehicles. With the enormous area covered by the Glasgow Corporation tramways system naturally reliable transport for the repairs department is absolutely essential, and that this reliability has been obtained with the use of Halley vehicles is indicated by the fact that the total value of spare parts purchased from the Halley's Industrial Motors since this public body first adopted Halley vehicles for their tower wagons up to November 30 last amounts to only £108 4s. 7d. for the whole fleet, which works out at an average of less than £3 15s. per vehicle per annum. This extremely low expenditure on replacements not only proves the wonderful durability of the Halley chassis, but reflects the very greatest credit on that branch of the Glasgow Corporation administration responsible for the care and upkeep of their tower wagons.

THE NEW TRACKLESS ROUTES AT KEIGHLEY.—The Hutley to East Barn, and the Keighley to Oakworth trackless car routes equipped by the Keighley Corporation have been formally inspected by Colonel Druitt, on behalf of the Board of Trade.

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MOTOR TRAFFIC.

Dennis Subvention Type Lorries.

The interesting and excellent photograph which we reproduce on this page illustrates a convoy of Dennis subvention type lorries on their way for delivery at the War Department's chief depot. The group, we may add, is limited in perspective by a curve in the roadway, but, although this may be unfortunate from the numerical point of view, it adds to rather than detracts from the excellence of the photograph as a picture.

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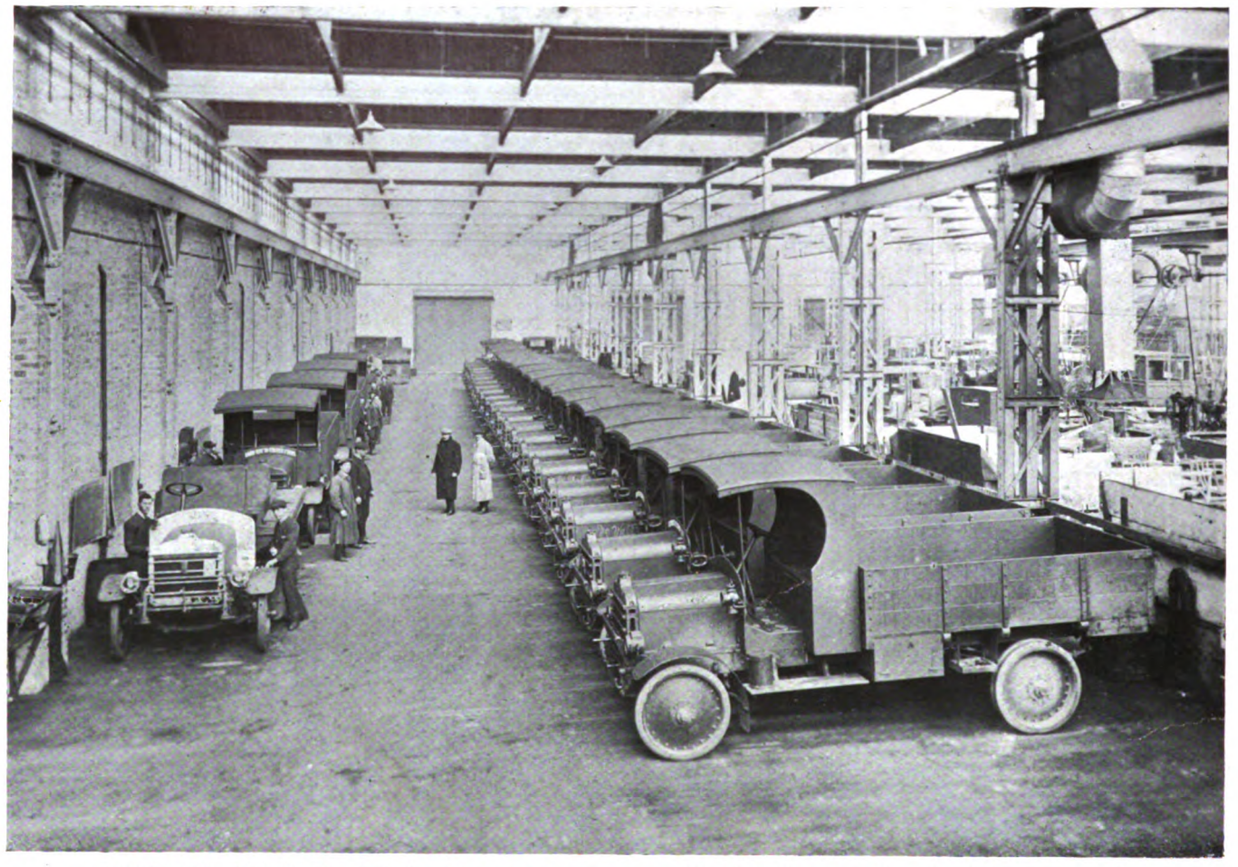

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Route Through Part of the Bitter Root Mountains as seen in Winter.

the Rocky Mountains) is characterised by long and severe gradients, because the train loads are very heavy, and above all because the high-pressure direct-current system is to be applied on a larger scale than ever before.

Plans for the electrification of the first division of the railway have now been completed and contracts have been let to the General Electric Company, of Schenectady, New York, for the electric locomotives, sub-station apparatus and line material, and to the Montana Power Company for the construction of the transmission and trolley lines. This initial electrification of 113 miles of main line between Three Forks

The plans of the Chicago, Milwaukee, and St. Paul Railway are also of especial importance, as this is the first attempt to install and operate electric locomotives on tracks extending over several divisions, under which conditions it is claimed the full advantage of electrification can be secured. The various terminal and tunnel installations in America have been made necessary, more or less, by reason of local conditions; but the electrification of this road is undertaken purely on economic grounds, with the expectation that superior operating results with electric locomotives will effect a sufficient reduction on the present cost of steam operation to return an attractive percentage on the large

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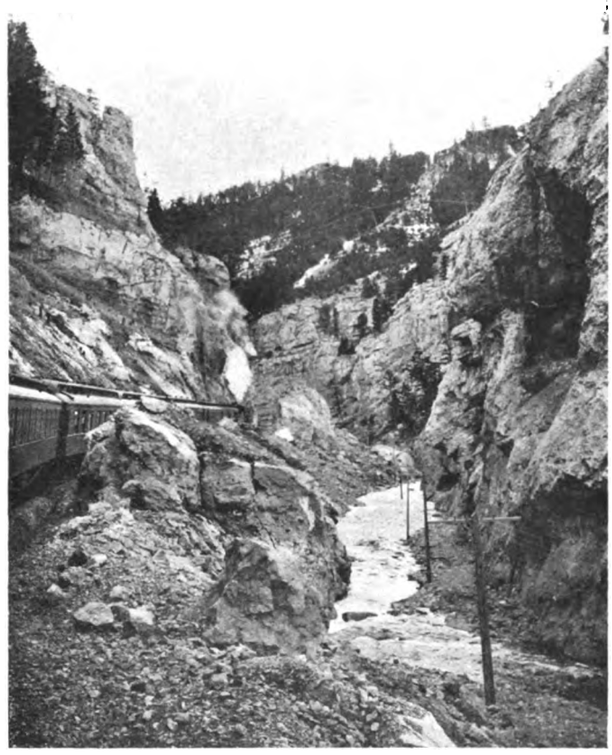
investment required. If the anticipated savings are realised in the electric operation of the road, this initial installation will constitute one of the most important milestones in electric railway progress, and it should foreshadow large future developments in heavy steam railway electrification. The success of electric working on such a large scale will, at least, settle the engineering and economic questions that enter into the advisability of making such an installation, and will limit similar future problems to the means of raising the capital required.

The Power Supply.

The first step taken towards electrification by the Chicago, Milwaukee, and St. Paul Railway was to enter into a contract with the Montana Power Company for an adequate supply of power over the 440 miles of main line considered for immediate electrification. The precautions taken both by the railway company



Course of the Railway Through the 16-Mile Canyon.

and the power company to ensure the continuity of power supply should guarantee a reliable source of power subject to few interruptions of a momentary nature only.

The Montana Power Company covers a great part of Montana and part of Idaho with its network of transmission lines, which are fed from a number of sources, of which the principal ones are tabulated below:

Madison River	11,000 KW.
Canyon Ferry	7,500 KW.
Hauser Lake	14,000 KW.
Big Hole	3,000 KW.
Butte (steam turbine)	5,000 KW.
Rainbow Falls	21,000 KW.
Small powers aggregating	7,390 KW.
Total power developed	68,890 KW.

Further developments, part of which are under construction, are as follows:

Great Falls	85,000 KW.
Holter	30,000 KW.
Thompson Falls	30,000 KW.
Snake River	20,000 KW.
Missoula River	10,000 KW.
Total	175,000 KW.

Total power capacity developed and undeveloped: 244,000 KW.

The several power sites are interconnected by transmission lines, supported on wooden poles and operating at 50,000 volts for the earlier installations, and on steel towers and operating at 100,000 volts for later installations. Ample water storage capacity is provided in the Hebgen Reservoir of 300,000 acre-feet, supplemented by an auxiliary reservoir capacity at the several power sites, which brings the total up to 418,000 acre-feet. The Hebgen Reservoir is so located at the head waters of the Madison River that water drawn from it can supply in turn the several installations on the Madison and Missouri Rivers, so that the same storage capacity is used a number of times, affording an available storage capacity considerably greater than is indicated by the figures given. It would seem, therefore, in changing from steam to electricity as the motive power, that the railroad is amply protected in respect to the reliability and continuity of the power supply.

Due to the great facilities available and the low cost of construction under the favourable conditions existing, the railway company will purchase power at a contract rate of $0·00536 (about 1⅓ farthings) per kilowatt-hour, based on a 60 per cent. load factor. It is expected under these conditions that the cost of power for locomotives will be considerably less than is now expended for coal. The contract between the railway and power companies provides that the total electrification between Harlowton and Avery, comprising four divisions, will be in operation by January 1, 1918.

In order to connect the sub-stations with the several feeding-in points of the Montana power transmission lines, a tie-in transmission line is being built by the railway company that will permit feeding each sub-station from two directions and from two or more sources of power. This transmission line will be constructed with wooden poles with suspension type insulators, will operate at 100,000-volts, and will follow, in general, the right of way of the railway company except where advantage can be taken of a shorter route over public domain to avoid the necessarily circuitous line of the railway in the mountain districts.

The immediate electrification of 113 miles will include four sub-stations containing step-down transformers and motor generator sets with necessary controlling switchboard apparatus to convert 100,000-volt, 60-cycle three-phase power to 3,000-volt direct current. This is the first direct-current installation using such a high potential as 3,000 volts, and this system was adopted in preference to all others after a careful investigation extending over two years. The 2,400-volt direct-current installation of the Butte, Anaconda, and Pacific Railway in the immediate territory of the proposed Chicago, Milwaukee, and St. Paul electrification has furnished an excellent demonstration of high-voltage direct-current locomotive operation during the past year and a half, and the selection of 3,000 volts direct current for the Chicago, Milwaukee, and St. Paul was due in a large measure to the entirely satisfactory performance of the Butte, Anaconda, and Pacific installation.

The equipment for this road was also furnished by the General Electric Company, of New York, and a comparison based on six months' steam and electric

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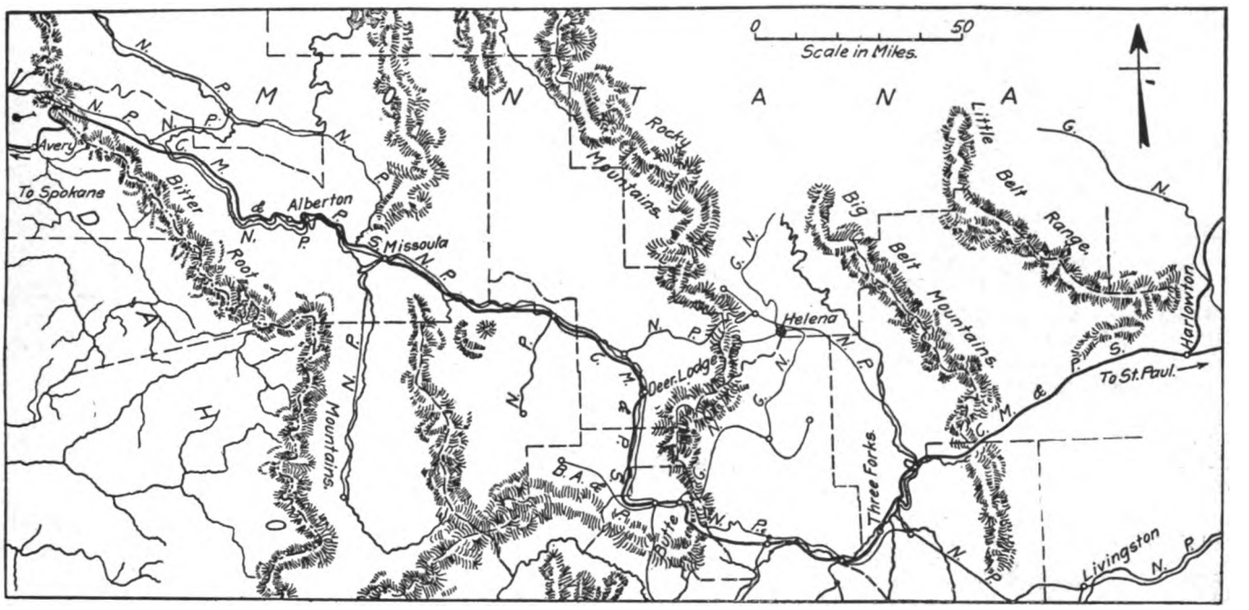
operation shows a total net saving of more than 20 per cent. on the investment or total cost of the electrification. These figures, of course, do not take into account the increased capacity of the lines, improvement to the service and the more regular working hours for the crews. The comparison also shows that the tonnage per train has been increased by 35 per cent., while the number of trains has been decreased by 25 per cent., with a saving of 27 per cent. in the time required per trip.



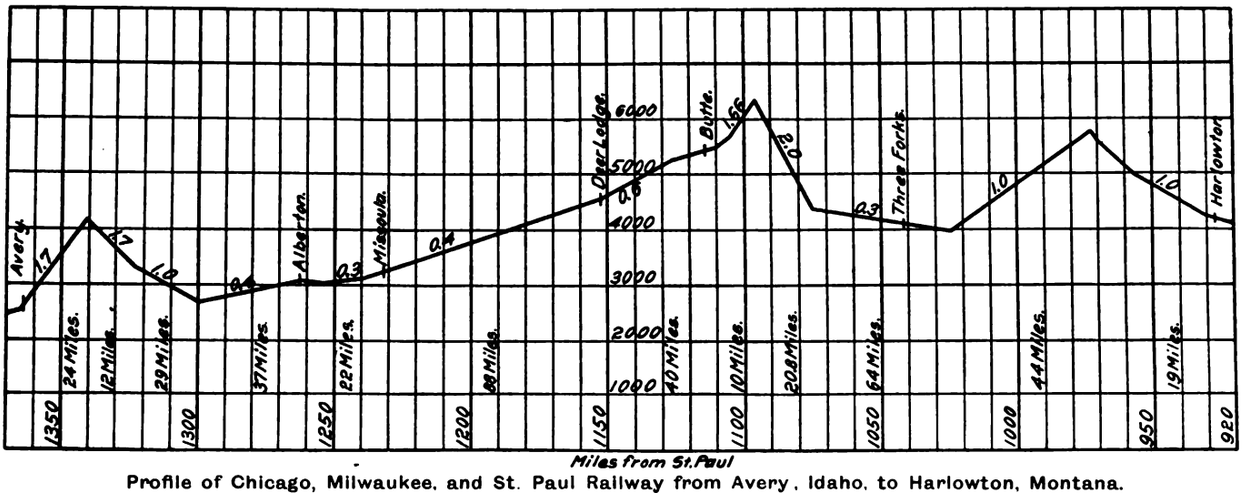
Outline Map Showing Route of Chicago, Milwaukee, and St. Paul Railway from Avery to Harlowton.

Sub-Stations.

The sub-station sites of the Chicago, Milwaukee, and St. Paul electrified zone provide for an average intervening distance of approximately 35 miles, notwithstanding that the first installation embraces 20·8 miles of 2 per cent. grade westbound and 10·4 miles of 1·66 per cent. grade eastbound over the main range of the Rocky Mountains. With this extreme distance between sub-stations, and considering the heavy traffic and small amount of feeder copper to be installed, it becomes apparent that such a high potential as 3,000 volts direct current permits of a minimum investment in sub-station apparatus and considerable latitude as to locations of sites.

The sub-stations will be of the indoor type, transformers being three-phase, oil cooled, and reducing from 100,000 volts primary to 2,300 volts secondary, at which potential the synchronous motors will operate. The transformers will be rated 1,900 and 2,500 K.V.A., and will be provided with four $2\frac{1}{2}$ per cent. taps in the primary and 50 per cent. starting taps in the secondary.

Each motor generator set will comprise a 60-cycle synchronous motor driving two 1,500-volt direct-current generators connected permanently in series for 3,000 volts. The fields of both the synchronous motor and the direct-current generators will be separately excited by small generators direct connected to each end of the motor generator shaft. The direct-current generators will be compound wound, will maintain constant potential up to 150 per cent. load, and will have a capacity for momentary overloads up to three times their normal rating. To insure good commutation on these overloads, the generators are equipped with commutating poles and compensating pole-face windings. The synchronous motors will also be utilised as synchronous condensers, and it is expected that the transmission line voltage can be so regulated thereby as to eliminate any effect of the fluctuating railway load.



Profile of Chicago, Milwaukee, and St. Paul Railway from Avery, Idaho, to Harlowton, Montana.

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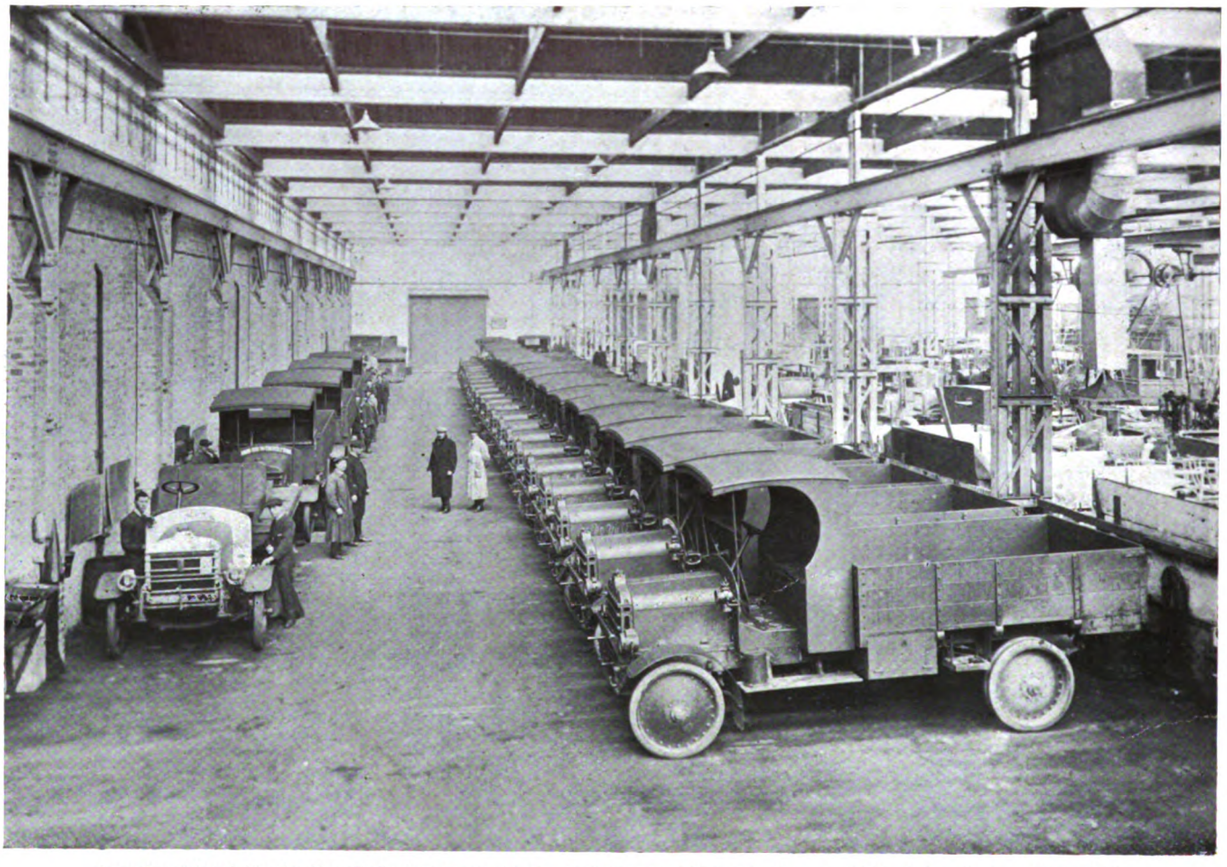

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The plans of the Chicago, Milwaukee, and St. Paul Railway are also of especial importance, as this is the first attempt to install and operate electric locomotives on tracks extending over several divisions, under which conditions it is claimed the full advantage of electrification can be secured. The various terminal and tunnel installations in America have been made necessary, more or less, by reason of local conditions; but the electrification of this road is undertaken purely on economic grounds, with the expectation that superior operating results with electric locomotives will effect a sufficient reduction on the present cost of steam operation to return an attractive percentage on the large

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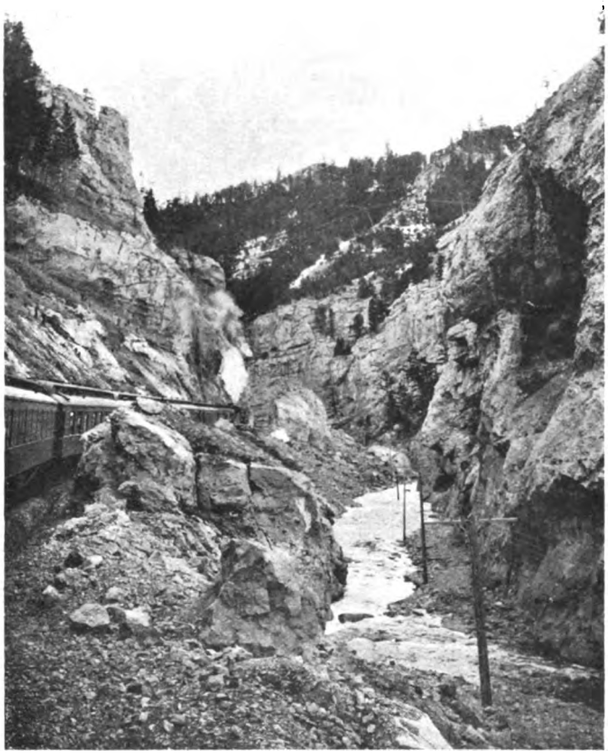
investment required. If the anticipated savings are realised in the electric operation of the road, this initial installation will constitute one of the most important milestones in electric railway progress, and it should foreshadow large future developments in heavy steam railway electrification. The success of electric working on such a large scale will, at least, settle the engineering and economic questions that enter into the advisability of making such an installation, and will limit similar future problems to the means of raising the capital required.

The Power Supply.

The first step taken towards electrification by the Chicago, Milwaukee, and St. Paul Railway was to enter into a contract with the Montana Power Company for an adequate supply of power over the 440 miles of main line considered for immediate electrification. The precautions taken both by the railway company



Course of the Railway Through the 16-Mile Canyon.

and the power company to ensure the continuity of power supply should guarantee a reliable source of power subject to few interruptions of a momentary nature only.

The Montana Power Company covers a great part of Montana and part of Idaho with its network of transmission lines, which are fed from a number of sources, of which the principal ones are tabulated below:

Madison River	11,000 KW.
Canyon Ferry	7,500 KW.
Hauser Lake	14,000 KW.
Big Hole	3,000 KW.
Butte (steam turbine)	5,000 KW.
Rainbow Falls	21,000 KW.
Small powers aggregating	7,390 KW.
Total power developed	68,890 KW.

Further developments, part of which are under construction, are as follows:

Great Falls	85,000 KW.
Holter	30,000 KW.
Thompson Falls	30,000 KW.
Snake River	20,000 KW.
Missoula River	10,000 KW.
Total	175,000 KW.

Total power capacity developed and undeveloped: 244,000 KW.

The several power sites are interconnected by transmission lines, supported on wooden poles and operating at 50,000 volts for the earlier installations, and on steel towers and operating at 100,000 volts for later installations. Ample water storage capacity is provided in the Hebgen Reservoir of 300,000 acre-feet, supplemented by an auxiliary reservoir capacity at the several power sites, which brings the total up to 418,000 acre-feet. The Hebgen Reservoir is so located at the head waters of the Madison River that water drawn from it can supply in turn the several installations on the Madison and Missouri Rivers, so that the same storage capacity is used a number of times, affording an available storage capacity considerably greater than is indicated by the figures given. It would seem, therefore, in changing from steam to electricity as the motive power, that the railroad is amply protected in respect to the reliability and continuity of the power supply.

Due to the great facilities available and the low cost of construction under the favourable conditions existing, the railway company will purchase power at a contract rate of $0·00536 (about 1⅓ farthings) per kilowatt-hour, based on a 60 per cent. load factor. It is expected under these conditions that the cost of power for locomotives will be considerably less than is now expended for coal. The contract between the railway and power companies provides that the total electrification between Harlowton and Avery, comprising four divisions, will be in operation by January 1, 1918.

In order to connect the sub-stations with the several feeding-in points of the Montana power transmission lines, a tie-in transmission line is being built by the railway company that will permit feeding each sub-station from two directions and from two or more sources of power. This transmission line will be constructed with wooden poles with suspension type insulators, will operate at 100,000-volts, and will follow, in general, the right of way of the railway company except where advantage can be taken of a shorter route over public domain to avoid the necessarily circuitous line of the railway in the mountain districts.

The immediate electrification of 113 miles will include four sub-stations containing step-down transformers and motor generator sets with necessary controlling switchboard apparatus to convert 100,000-volt, 60-cycle three-phase power to 3,000-volt direct current. This is the first direct-current installation using such a high potential as 3,000 volts, and this system was adopted in preference to all others after a careful investigation extending over two years. The 2,400-volt direct-current installation of the Butte, Anaconda, and Pacific Railway in the immediate territory of the proposed Chicago, Milwaukee, and St. Paul electrification has furnished an excellent demonstration of high-voltage direct-current locomotive operation during the past year and a half, and the selection of 3,000 volts direct current for the Chicago, Milwaukee, and St. Paul was due in a large measure to the entirely satisfactory performance of the Butte, Anaconda, and Pacific installation.

The equipment for this road was also furnished by the General Electric Company, of New York, and a comparison based on six months' steam and electric

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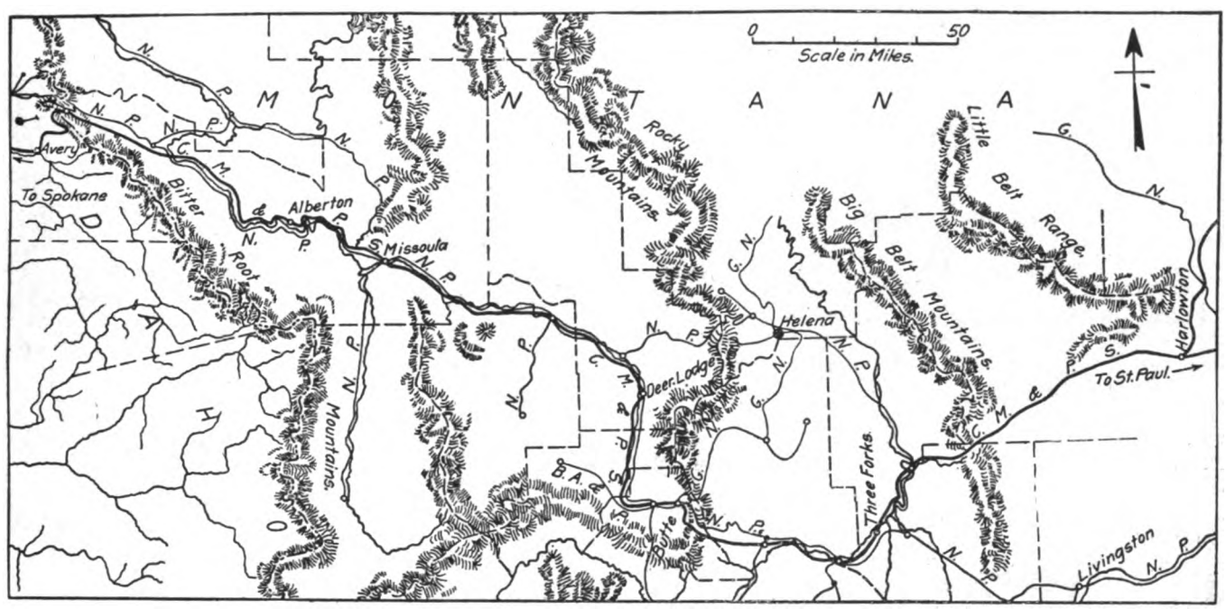
operation shows a total net saving of more than 20 per cent. on the investment or total cost of the electrification. These figures, of course, do not take into account the increased capacity of the lines, improvement to the service and the more regular working hours for the crews. The comparison also shows that the tonnage per train has been increased by 35 per cent., while the number of trains has been decreased by 25 per cent., with a saving of 27 per cent. in the time required per trip.

The sub-stations will be of the indoor type, transformers being three-phase, oil cooled, and reducing from 100,000 volts primary to 2,300 volts secondary, at which potential the synchronous motors will operate. The transformers will be rated 1,900 and 2,500 K.V.A., and will be provided with four 2½ per cent. taps in the primary and 50 per cent. starting taps in the secondary.

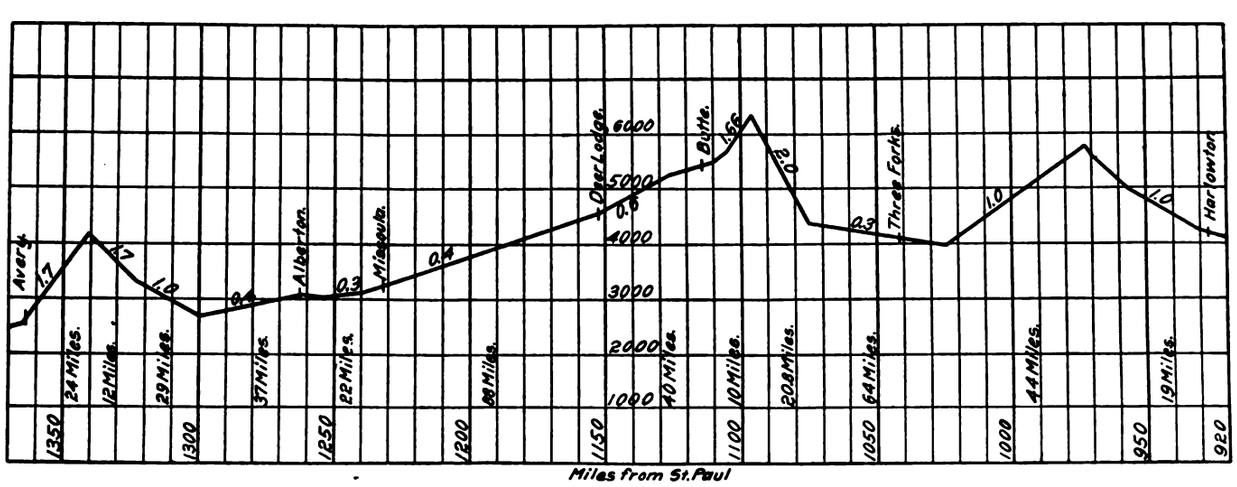


Outline Map Showing Route of Chicago, Milwaukee, and St. Paul Railway from Avery to Harlowton.

Sub-Stations.

The sub-station sites of the Chicago, Milwaukee, and St. Paul electrified zone provide for an average intervening distance of approximately 35 miles, notwithstanding that the first installation embraces 20·8 miles of 2 per cent. grade westbound and 10·4 miles of 1·66 per cent. grade eastbound over the main range of the Rocky Mountains. With this extreme distance between sub-stations, and considering the heavy traffic and small amount of feeder copper to be installed, it becomes apparent that such a high potential as 3,000 volts direct current permits of a minimum investment in sub-station apparatus and considerable latitude as to locations of sites.

Each motor generator set will comprise a 60-cycle synchronous motor driving two 1,500-volt direct-current generators connected permanently in series for 3,000 volts. The fields of both the synchronous motor and the direct-current generators will be separately excited by small generators direct connected to each end of the motor generator shaft. The direct-current generators will be compound wound, will maintain constant potential up to 150 per cent. load, and will have a capacity for momentary overloads up to three times their normal rating. To insure good commutation on these overloads, the generators are equipped with commutating poles and compensating pole-face windings. The synchronous motors will also be utilised as synchronous condensers, and it is expected that the transmission line voltage can be so regulated thereby as to eliminate any effect of the fluctuating railway load.



Profile of Chicago, Milwaukee, and St. Paul Railway from Avery, Idaho, to Harlowton, Montana.

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The location and equipment of the several sub-stations is as follows:

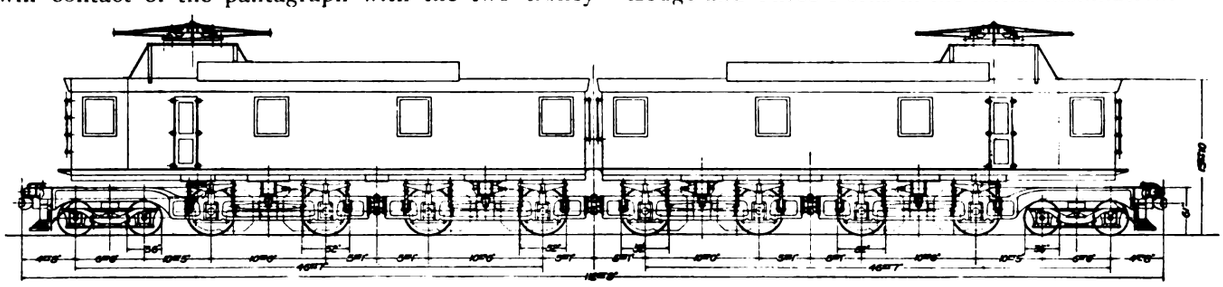
Stations.	Miles from Deer Lodge.	No. of Units.	Kw. per Unit.	Total.
Morel	17·1	2	2,000	4,000
Janey	50·5	3	1,500	4,500
Piedmont	77·9	3	1,500	4,500
Eustis	120·6	2	2,000	4,000

Overhead Construction.

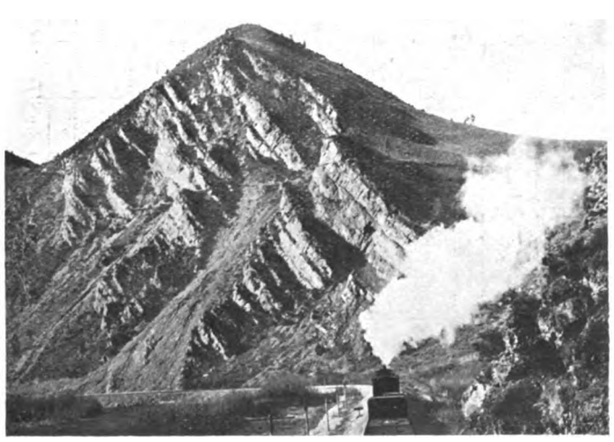
The trolley construction will be of the catenary type, in which a 4/0 trolley wire is flexibly suspended from a steel catenary supported on wooden poles, the construction being bracket wherever track alignment will permit, and cross-span on the sharper curves and in yards. Steel supports instead of wooden poles will be used in yards where the number of tracks to be spanned exceeds the possibilities of wooden pole construction. Poles for the first installation are already on the ground, and 30 miles of poles are set. Work in this direction will be pushed with all speed, and will be completed in the summer of 1915, ready for operation in the autumn on the delivery of the first locomotives.

As the result of careful investigation and experiments, a novel construction of trolley will be installed, composed of the so-called twin-conductor trolley. This comprises two 4/0 wires suspended side by side from the same catenary by independent hangers alternately connected to each trolley wire. This form of construction permits the collection of very heavy current by reason of the twin contact of the pantagraph with the two trolley wires, and also ensures sparkless collection under the extremes of either heavy current at low speed or more moderate current at very high speeds. It seems that the twin-conductor type of construction is equally adapted to the heavy grades calling for the collection of very heavy currents, and on the more level portions of the profile where maximum speeds of 60 miles per hour will be reached with the passenger trains having a total weight of over 1,000 tons. The advantage of this type of construction is due partly to the greater surface for the collection of current, but largely to the very great flexibility of the alternately suspended trolley wires, a form of construction which eliminates any tendency to flash at the hangers either at low or high speed. Including sidings, passing and yard tracks, the 113 miles of route mileage is increased to approximately 168 miles of single track to be equipped between Deer Lodge and Three Forks in the initial installation.

Great Falls, Montana, on Missouri River.
(At site of 60,000-kw. Hydro-electric Station.)



Elevation of 3,000-Volt Locomotive for the Chicago, Milwaukee, and St. Paul Railway.



Curve at Base of "Towering Mountain Top."
(Part of Route to be Electrified.)

Locomotives.

The locomotives to be manufactured by the General Electric Company are of especial interest for many reasons. They are the first locomotives to be constructed for railroad service with direct-current motors designed for so high a potential as 3,000 volts. They will weigh approximately 260 tons, and will have a continuous capacity greater than any steam or electric locomotive yet constructed. Perhaps the most interesting part of the equipment is the control, which is arranged to effect regenerative electric braking on down grades. This feature as yet has never been accomplished with direct-current motors on so large a scale. The proposed characteristics are tabulated below:

Total weight	260 tons.
Weight on drivers	200 tons.
Weight on each guiding truck	30 tons.
Number of driving axles	8
Number of motors	8
Number of guiding trucks	2
Number of axles per guiding truck	2
Total length of locomotive	112 ft.
Rigid wheel base	10 ft.
Voltage of locomotive	3,000
Voltage per motor	1,500
H.P. rating, one hour—each motor	430
H.P. rating, continuous—each motor	375
H.P. rating, one hour—complete locomotive	3,440
H.P. rating, continuous—complete locomotive	3,000
Trailing load capacity, 2 per cent. grade	1,250 tons.
Trailing load capacity, 1 per cent. grade	2,500 tons.
Approximate speed at these loads and grades	16 m.p.h.

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The Chicago, Milwaukee, and St. Paul Railway, from Harlowton to the coast, crosses four mountain ranges: the Belt Mountains at an elevation of 5,768 ft., the Rocky Mountains at an elevation of 6,350 ft., the Bitter Root Mountains at an elevation of 4,200 ft., and the Cascade Mountains at an elevation of 3,010 ft. The first electrification between Three Forks and Deer Lodge calls for locomotive operation over 20·8 miles of 2 per cent. grade between Piedmont and Donald at the crest of the main Rocky Mountain Divide, so that the

Goods Train Climbing Gradient of 2 in 100.

locomotives will be fully tested out as to their capacity and general service performance in overcoming the natural obstacles of the first division.

The initial contract calls for nine freight and three passenger locomotives having the above characteristics and similar in all respects, except that the passenger locomotives will be provided with a gear ratio permitting the operation of 800-ton trailing passenger trains at approximately 60 miles per hour, and will, furthermore, be equipped with an oil-fired steam heating outfit for the trailing cars.

The cab consists of two similar sections extending practically the full length of the locomotive. Each section is approximately 52 ft. long, and the cab roof is about 14 ft. above the rail, exclusive of the housings for ventilation. The trolley bases are about 5 ft. above the roof owing to the unusual height of the trolley wire, which will be located at a maximum elevation of 25 ft. above the rail. The outer end of each cab will contain a compartment for the engineer, while the remainder is occupied by the electric control equipment, train heater, air brake apparatus, etc.

Motors.

The eight motors for the complete locomotive will be type GE-253-A. This motor has a normal one-hour rating of 430 H.P. with a continuous rating of 375 H.P. The eight motors will thus give the locomotive a one-hour rating of 3,440 H.P. and a continuous rating of 3,000 H.P., which makes it more powerful than any steam or electric locomotive ever built. The drawbar pull available for starting trains will approximate 120,000 lb. at 30 per cent. coefficient of adhesion.

Each motor will be twin-geared to its driving axle in the same manner as on the Butte, Anaconda, and Pacific, the Detroit River Tunnel, and the Baltimore and Ohio locomotives, a pinion being mounted on each end of the armature shaft. The motor is of the commutating-pole type and has openings for forced ventilation from a motor-driven blower located in the cab.

The freight locomotives are designed to haul a 2,500-ton trailing load on all gradients up to 1 per cent. at a speed of approximately 16 miles per hour, and this same train load unbroken will be carried over the 1·66 and 2 per cent. ruling grades on the west and east slopes of the Rocky Mountain Divide with the help of a second similar freight locomotive acting as pusher. Track provision is being made at Donald, the summit of the grade, to enable the pusher locomotive to run around the train and be coupled to the head end to permit electric braking on the down grade. In this case, the entire train will be under compression and held back by the two locomotives at the head end, the entire electric braking of the two locomotives being under the control of the motorman in the operating cab of the leading locomotive. It is considered that electric braking will prove very valuable in this mountain rail roading, for in addition to providing the greatest safety in operation, it also returns a considerable amount of energy to the sub-stations and transmission system, which can be utilised by other trains demanding power. In this connection, the electric locomotives will have electric braking capacity sufficient to hold back the entire train on down grade, leaving the air brakes with which they are also equipped to be used only in emergency and when stopping the train. There is, therefore, provided a duplicate braking system on down grades, which should be reflected in the greatest safety of operation and the elimination of a considerable part of breakdowns, wheel and track wear, and overheating, with consequent reduction in maintenance and improvement in track conditions.

With the completion of the remaining divisions, it is proposed to take advantage of the possibilities afforded by the introduction of the electric locomotive by combining the present four steam engine divisions into two locomotive divisions of approximately 220 miles length, changing crews, however, at the present division points. As the electric locomotive needs inspection only after a run of approximately 2,000 miles, requires

Electric Ore Train on Butte Railway at Silver Bow.

no stops for taking on coal or water, or lay-over due to dumping ashes, cleaning boilers, or petty round-house repairs, it is expected that the greater flexibility of the locomotive so provided will result in considerable change in the method of handling trains now limited by the restrictions of the steam engine.

The electrification of the Chicago, Milwaukee, and St. Paul is under the direction of Mr. C. A. Goodnow, assistant to the president in charge of construction, and the field work is under the charge of Mr. R. Beeuwkes, electrical engineer for the railway company.

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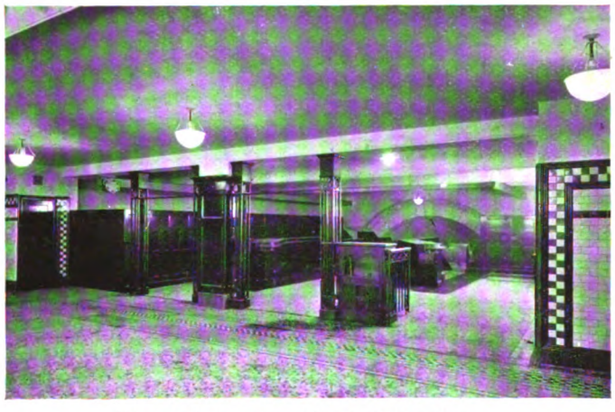
THE WILLESDEN EXTENSION OF THE BAKERLOO RAILWAY.

The greater part of the extension of the Baker Street and Waterloo Railway from Paddington to Queen's Park, Willesden, was opened for public traffic on January 31. The opening of the remainder between Kilburn Park and Queen's Park was postponed for a short time pending the completion of the passenger platforms at the latter station, but it will also be opened in a few days. The arrangements at the new stations are in every respect admirable. They show, indeed, that with every extension of the underground system those responsible for the designs and construction make further advances in meeting the convenience of the public; and passengers whose enthusiastic approval is not won by the evident care which has been devoted to their interests must be hard to please.

The scheme for linking up the Baker Street and Waterloo Railway with the new electric line of the London and North Western Railway from Euston to Watford has on previous occasions been explained in our pages. For present purposes, therefore, it is sufficient to say that the junction of the two lines is at Queen's Park, and that when the North Western Company's electric railway is completed through trains will be run between the Elephant and Castle in South London and Watford. This is the first tube railway to be connected with a main line railway, and as other such connections are in prospect the present event is of special importance.

The length of the extension from Paddington to Queen's Park is two miles, of which $1\frac{3}{4}$ miles (from Paddington to Kilburn Park) is in twin tube tunnels, and $\frac{1}{4}$ mile (from Kilburn Park to Queen's Park) is in the open, the railway coming to the surface to make the junction with the London and North Western line. The total length of the Bakerloo Railway, from the Elephant and Castle to Queen's Park, is now seven miles. The tunnels are similar in construction to those of the remainder of the line, being driven by cutting shields and lined with iron in segments. The diameter of each tube on the straight is 11 ft. $8\frac{1}{4}$ in., on curves 12 ft., and in stations 21 ft. $2\frac{1}{2}$ in. The permanent way is like that on the rest of the Bakerloo Railway, which has given such excellent results. The sleepers rest on



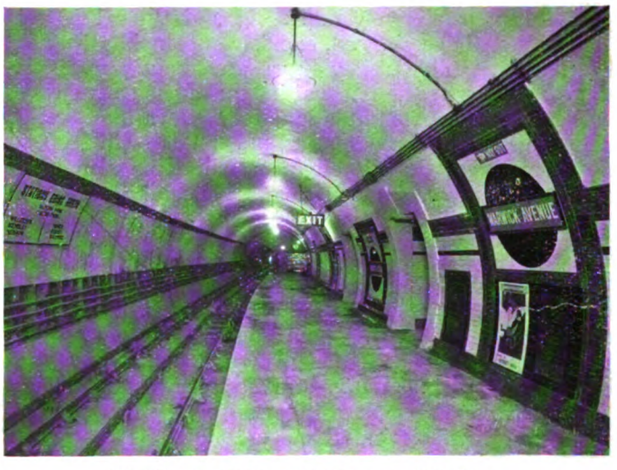
Warwick Avenue—Head of Escalator.

a concrete bed; their ends overhang so as to give elasticity to the track; the third and fourth conductor rails are also uniform with those on the older part of the line. The spaces between the sleepers are filled up flush with slagwool. There are the usual approach and departing track gradients at the stations. There is also a general gradient from south to north of 1 in 200, but where the line rises to the surface the up slope is 1 in 40. The curves are of 20 and 40 chains radius. In the construction of the tunnels four working shafts were provided at intervals, and operations have been in progress since November, 1912.

At all of the four new stations, Warwick Avenue, Maida Vale, Kilburn Park, and Queen's Park, the

Kilburn Park Entrance.

trouble of fixed stairs forming part of the descent to and ascent from the station platforms has been avoided. Instead of lifts, escalators or moving staircases (of the Otis Elevator Company's make) have been installed, and in most cases these lead direct from the booking halls to the station platforms. For the sake of the specially timid, and to meet the improbable case of a complete breakdown of the machinery, a fixed stair is provided between the descending and the ascending escalator. The latter are capable of carrying 12,000 people in each direction per hour, and their speed is 90 ft. per minute. The stations are not so deep as most of those on existing tube railways, the depths below the surface being: Warwick Avenue and Kilburn Park, 34 ft.; Maida Vale, 38 ft. Kilburn Park Station is worthy of special mention as it is so spacious and well lighted. By day no artificial light is required



Platform of Warwick Avenue Station.

except at the low level. Maida Vale Station will not be opened till April.

Queen's Park is the original North Western station much enlarged, the Bakerloo lines coming between the new North Western electric tracks. There are two island platforms, the outer sides of which are used by the North Western Company, and the inner by the

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Booking Hall, Kilburn Park.

Escalator at Kilburn Park.

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London Electric Company. A shed to the west of the station spans four lines, two of which are running tracks and two are sidings. Here cars can be stored and also inspected, as pits are provided. The station signal box contains an electro-pneumatic frame with 21 working levers and the usual illuminated track diagram. The automatic signalling system on the extension generally is similar to that on the older part of the line, except that alternating current is used for the signalling instead of direct current. A car repair shop has been provided close to Queen's Park Station as an auxiliary to the Bakerloo shops at London Road (near Waterloo).

The power supply, of course, comes from the Chelsea generating station, and is transmitted through the existing sub-station at Edgware Road and a new sub-station at Kilburn Park where transforming and converting plant of a capacity of 3,600 KW. is installed.

The additional rolling stock required comprises 10 motor cars by the Brush Company, two motor cars and two trailers by the Leeds Forge Company, 10 trailer cars which have been transferred from the Hampstead line of the railway company, seven trailer cars converted to motor cars at the company's Golder's Green works, and three motor cars transferred from the company's Piccadilly railway. A description of typical cars appeared in our issue of January 14. There is a two and a half-minute service of trains during the rush hours and three and a half-minutes at other times. The schedule time for the whole seven miles' journey between the Elephant and Castle and Queen's Park is 25 minutes.

The consulting engineer for the construction of the railway was Mr. H. H. Dalrymple-Hay; Mr. Z. E. Knapp was construction engineer for the London Electric Railway Company; Mr. A. R. Cooper was engineer for that company; and Mr. M. I. Jones was resident engineer. The contractors for the tunnel work were Messrs. Scott and Middleton, and those for the cut-and-cover and the open parts were Messrs. John Mowlem and Company. The British Thomson-Houston Company were responsible for the electric equipment of the trains.

On January 29, by invitation of the London Underground Railway, representatives of the press went over the new line, when the railway officers who were present included Mr. W. E. Mandelick, secretary and business manager; Mr. H. E. Blain, operating manager; Mr. W. E. Blake, superintendent; Mr. W. A. Agnew, mechanical engineer; Mr. Z. E. Knapp, manager for maintenance and construction; and Mr. J. W. Towle, superintendent engineer of Chelsea power-station; together with Mr. J. P. Thomas, superintendent of the London General Omnibus Company; and Mr. P. V. MacMahon, engineer of the City and South London Railway.

At a luncheon which followed the inspection, Mr. Mandelick pointed out that the desire of the directors was to do everything possible to enable the London public to get out into the country rapidly, conveniently, and cheaply. The delay in completing Queen's Park Station had been due to scarcity of labour, and to delay in the delivery of materials.

Electric Lighting on Indian Railways.—The Railway Board propose to abandon the use of gas for train lighting and to equip all passenger trains with electric light.

L'Industrie des Tramways et Chemins de Fer. We welcome the reappearance of this useful publication of the French Tramways' Union. After suffering a three months' eclipse since the issue of July last, a number covering August, September, and October has been issued. The contents, owing to *force majeure*, are rather belated, but are none the less important as matters of record, and we congratulate Mons. A. Coste, the editor of the journal and secretary of the Union, on having overcome all obstacles, which we hope and trust have now disappeared for ever.

LIVERPOOL TRAMWAY REPAIR SHOPS.

Reconstruction and New Equipment.

The era of electric traction as applied to the tramway systems of the large provincial centres of Great Britain is now nearing the end of its second decade. Glasgow, Liverpool, Leeds, and Sheffield were the pioneer cities of the new system which revolutionised urban traffic 17 and 18 years ago; and, as they were first then, so they have since been among the foremost in developing and adapting their undertakings to changing conditions. It is interesting to note the various methods by which they have kept abreast of the times. Each has had its own particular problems to tackle, and each has solved, or is solving them in its own particular way, though none has been too prejudiced to learn from the others.

When some of the leading Corporations decided to undertake the construction as well as the maintenance of their rolling stock, it became apparent that their existing facilities, especially as regards buildings and plant, would prove before long to be inadequate to their needs. This is the particular problem which the Liverpool undertaking has recently had to face, and it is proposed in the course of the present article to give some details of the work of reorganisation and reconstruction now being effected at the car works.

As regards the maintenance and repair of rolling stock, the Liverpool policy has always been one of centralisation. The six depots at Walton, Green Lane, Smithdown Road, Dingle, Garston, and Litherland exist merely as car sheds. There the cars are housed, cleaned, and oiled, but everything else is done at the central works in Lambeth Road. This building provides accommodation ordinarily for some 60 or 70 cars, but there would be room for 100 if required. Increased floor space was not so much desired as a rearrangement of the works with a view expeditiously to overhauling the cars.

At the beginning of 1913 the general manager decided to introduce a new system of overhauling cars with a view to improving the rolling stock and eliminating noise as far as possible; and to this end he improvised a system of periodical overhaul, by which a minimum of six cars are dealt with every week. The cars are overhauled in a very thorough manner, the bodies being lifted from the trucks to permit a complete inspection of the latter and the replacement of any worn parts, while the bodies are cleaned, "touched up," and varnished, so that the vehicles are turned out in spick-and-span condition. By this method 600 cars undergo a complete overhaul every two years, and with the new facilities now becoming available the work will ultimately be speeded up to such an extent that each car will get practically an annual overhaul.

Liverpool has now 600 cars, and with the exception of a score or so of "spare" vehicles, all are top-covered. The original 450, the bulk of which were built by Dick, Kerr and Company, Limited, had no top covers, but these have since been added by the Corporation, who have built the remaining 150 cars at their own works, with the exception of two experimental sample cars delivered by the United Electric Car Company, of Preston, a couple of years ago. As Liverpool was one of the pioneers of electric traction, the motors were of an early type, being only of 25 B.H.P. The speeding-up tendency and the increasing weight of cars owing to the provision of top covers demanded a more powerful motor, so 40-B.H.P. interpole motors of the D.K.-20 type with 5 in. gears, and having oil lubrication throughout, were introduced. Up to the present about 100 of

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the original 450 cars have been equipped with these 40-H.P. motors in place of the former 25-H.P. type.

For the complete overhaul and re-equipment of such a large number of cars under Mr. Mallins' scheme of reorganisation, the existing facilities at the works proved somewhat inadequate. Attention was directed to the provision of better means for dealing expeditiously with the work. The method of lifting the bodies from the trucks by ordinary jacks was too slow, and other means, such as hydraulic jacks and moving platforms, received consideration. Mr. Mallins eventually decided in favour of travelling cranes, and one of these, with a lifting capacity of 15 tons, running the whole length of the works has just been installed. It was found necessary to raise the roof by 16 ft. for the provision of a commanding gallery, 315 ft. long and 18 ft. wide, along the side of the works where the crane runs. This gallery also extends at present partly across the ends of the building, and it is intended eventually to duplicate the gallery and travelling crane on the other side of the works, so that when the reconstruction is completed the gallery will extend all round the building. The car works consisted of four parallel bays, and under the present scheme the building will receive an additional 64 ft. in width by an extension on the Lambeth Road side. At the same time the roof will be raised over all four bays by 16 ft. The widening of one bay to 61 ft. 7 in. and the raising of its roof to the required height to accommodate the gallery and travelling crane has already been completed.

The accompanying illustrations show views of the completed bay. Previous to the construction of the new gallery, all work connected with the electrical equipment of the cars was carried out in an armature room at one end of the building. That work is now performed in the gallery, which is provided with the necessary tools and fittings for armature winding and for dealing with the controllers, bells, and other electrical parts. On the floor space immediately below the gallery are the wheel press, wheel-tiring plant, wheel-turning lathe, and other machinery required for truck maintenance and repair.

The great utility of the new arrangement is at once apparent. On a car entering the works for overhaul it is run into this bay, when the body is lifted off the truck and placed on trestles across one of the pits, the armatures being raised by the crane to the gallery above, while the wheels are dealt with just below. This expeditious handling supersedes the laborious method formerly in vogue of jacking up the body and carrying the electrical parts to the old armature room on a higher floor. It also provides for the complete separation of the coach-builders' and painters' work from the mechanical part of the undertaking. Formerly this work had to be carried out at the same place in the same time, but now the two classes of labour can work without interrupting or impeding each other. A new paint shop, commodious and well-lighted, has been provided for the body department. The old armature room is to be fitted up as a messroom with accommodation for 400 men, and a range of three electric ovens will be installed here. At the opposite end of the reconstructed bay are timber storage rooms on both floors with large openings admitting a continuous

View of Reconstructed Bay in Liverpool Tramway Repair Shop, Showing New Electric Travelling Crane.

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current of air for drying and seasoning the wood. The travelling crane is also brought into requisition for lifting timber to the upper chamber. The old fitting shop is now used for automobile work, the Corporation having a fleet of 16 motor vehicles of various types.

It must be understood that the whole scheme of

Wheel-Repairing Plant at Liverpool Tramway Repair Works.

reconstruction devolved upon the system of periodically overhauling the cars, as devised by Mr. Mallins. The new facilities at the car works have been designed with a view to dealing expeditiously with this particular work as distinct from the normal repairing routine. The reconstruction was commenced some nine months ago, and it is being carried out entirely by the Corporation and its own employees. On January 19 the

Armature Winding in the New Gallery at Liverpool Tramway Repair Works.

Tramways Committee, accompanied by the Lord Mayor, visited the car works in order to inspect the new developments. This visit formed part of a tour of inspection of the tramways undertaking, which is referred to elsewhere in this issue.

Trackless Trolley for Tees-side.—A scheme for the establishment of a trackless trolley service between Middlesbrough, Grangetown, and South Bank has been formulated.

Prizes for Invaders of Germany.—The directors of the British "Berna" offer £25 to the first driver, in Government service, of a British "Berna" lorry that gets over the Rhine and £50 to the first driver of a British "Berna" lorry that enters Berlin.

"SAFETY FIRST" MOVEMENT IN CHICAGO.

Mr. H. L. Brownell, "safety inspector" of the Chicago surface lines, is making a thorough and systematic effort to reduce the accidents on the tramways of that city. The campaign began with lectures to children in the board schools, and the results were so satisfactory that the Board of Education itself has decided to carry on the work begun by the companies. At the request of the Board 10,000 copies of a pamphlet entitled "Safety First" have been supplied to it for the use of teachers in instructing the children. Lithographed illustrations 14 ins. by 18 ins. in size, giving what may be described as "terrible examples," are hung in the schoolrooms throughout the city. Several of these illustrations are here reproduced from *Electric Traction*, of Chicago. One of these is a new "Safety First" illustration which has been issued by the company in order to impress upon parents and others in charge of children the danger which is incurred by them in playing in the streets.

Many accidents in Chicago result from carelessness on the part of the drivers of vans which have discharged garden produce and are returning home. The

Join The Public Safety Crusade
PARENTS—ATTENTION
THE SAFETY OF THE CHILDREN DEPENDS ON YOUR ASSISTANCE
WARN. INSTRUCT. PREVENT THEM FROM PLAYING ON THE TRACKS
5372

"A Dangerous Place to Play"

drivers often fall asleep, leaving the horses to pick their way along the streets. To remedy this a special appeal has been made to the Gardeners and Farmers' Association, and the danger has been explained to them by Mr. Brownell in a special letter. This is only one of many ways in which it is hoped to diminish the number of street accidents.

Mr. Brownell was recently invited by the Park Commissioners of St. Louis to repeat the lectures, illustrated by moving pictures, in that city, and these were listened to by over 18,000 persons. In Dayton, Ohio, 10,000 school children were shown the film pictures.

The warnings are not confined to children, as the following injunctions to adults clearly show. It will be seen that these rules are designed to awaken attention and to impress upon the mind of the reader the fact that to secure safety in busy thoroughfares it is necessary that great care should be taken.

FOR GROWN-UPS—SAFETY GOLDEN RULES.

1. Look at it from the other fellow's viewpoint.
2. Co-operate with him to use the streets, sidewalks, cars, and buildings on the equal right basis of traffic.
3. Pedestrians on the streets, give an equal right to that automobile, street car, or other pedestrian.
4. Owners and operators of automobiles, respect the rights of others; the pedestrians on the streets have as much right to the use of that street as you have, and

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your forcing them to submit to your domination will call for drastic legislation on motor car users.

5. Mr. Business Man, you may be the brightest man in town in other ways, yet if you get in front of an automobile or street car, which are not respecters of persons, you will be hurt more than the man in the so-called lower walk of life.

6. Owners and operators of auto trucks, see that your trucks are operated more carefully, especially in the congested districts and in the vicinity of schools, as the daily toll of injuries to children will force severe penalty if the remedy of carefulness is not applied at once.

7. Everyone, stop, look, and think "safety" before you cross a congested street or pass behind a car, automobile, or wagon. Always see what is on the other side of the object you are passing. Cross the street on a crosswalk. Don't start until you know it is safe to cross, then keep on going; don't stop and turn back. Don't run, walk fast. Don't rock the boat when out rowing or canoeing. Go ashore to change seats. Don't take chances when in bathing.

8. All users of the street, do not crowd pedestrians into a place of danger with your automobile, wagon, or street car, or dash into a crowd on a crosswalk in the absence of a crossing policeman, and even if the policeman is at that crossing, and gives you the signal to proceed, go safely and carefully. All drivers of vehicles, avoid accidents by not driving in the street car tracks; you also delay the passengers by using the tracks. Look out for street cars when you cross tracks. Always look for the other car, the one on the other track, when you drive behind a car. Look for car before you swing on to track.

9. All users of the street, remember the child and the aged. You were a child once and know how much you looked up to your elders and followed their example and depended upon them. Help that child by your example of safety and assist the aged, as you will probably reach that advanced state in the future.

10. Get the safety habit: practice it and help others to acquire the same habit.

H. L. Brownell, Safety Inspector,
Chicago Surface Lines.

CHILDREN'S FARES AT BIRMINGHAM.

Substantial reduction has been made in the ordinary fares for children on Birmingham Corporation tramways. Hitherto children have been carried on the tramcars free up to three years of age, and from that age up to 12 they have enjoyed the privilege of riding any distance of one journey for a penny, irrespective of whether they were school children or not. When the committee took over the motor omnibuses from the motor omnibus company in October last they found that it had been the custom of the company to charge half-fares for school children up to 15 years of age. This was done by means of the sale of tickets in bundles of 100 at 4s. 2d. each bundle, which could only be purchased at the company's depots. This system did not meet with the approval of the committee; and when they came into possession of the omnibuses they discontinued it pending a consideration of the whole subject, which, of course, involved the application of equal terms to children riding on tramcars or omnibus. Now the committee have instituted a system of cheap fares applicable both to tramcars and omnibuses which can be paid on the vehicles direct to the conductors, thus obviating the necessity of obtaining the tickets in bulk from the offices. In accordance with the new scale all children under three years of age will be carried free, and the fares for chidren between three and 14 years of age will be as follows:

All ordinary 1d. stages	½d.
All ordinary 1½d. and 2d. stages	1d.
All ordinary 2½d. and 3d. stages	1½d.
All ordinary 3½d. and 4d. stages	2d.

Birmingham people, as a rule, are not favourably disposed towards a farthing currency, and therefore no provision has been made for three farthings, penny farthing, or penny three farthings fares; but, taking the scale as a whole, including the raising of the age from 12 to 14, the children secure a corsiderable advantage by the new system.

ABERDARE TRAMWAYS AND RAILLESS TRACTION EXTENSIONS.

The Aberdare Urban District Council (Tramways, etc.) Bill on Tuesday, January 19, passed the examiners and was sent for first reading when Parliament meets.

The bill enables the Council to construct and maintain tramways, to run trolley cars by railless traction and motor 'buses, and to carry out street improvements. The total expenditure is estimated at £65,860, made up as follows:

Construction and equipment of tramways and tramroad ...	£43,752
Installation of railless traction and necessary apparatus plant	5,906
Provision and equipment of motor omnibuses...	8,500
Street widenings	3,600
Laying-out recreation ground	2,600
Purchase of lands and buildings	1,502
Total	£65,860

The aggregate length of the three proposed tramway extensions is 5 miles 8·70 chains. The principal extension (2 miles 2 furlongs 0·30 chains in length) from the termination of the Cemetery Road tramway to Hirwain will be constructed as a tramroad, of which 1¾ miles will be upon waste or open ground.

Weather Shields for Tramcar Drivers.—The Tottenham Urban District Council have passed the following resolution: "That having regard to the great inconvenience to tramway drivers caused by wind and rain when driving tramway cars in bad weather, the London County Council, the Metropolitan Electric Tramways, Limited, and the Middlesex County Council be asked to consider the desirability of providing some means of protection for the men, either in the shape of a portable shield or otherwise."

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THE
Tramway and Railway World

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LONDON, FEBRUARY 11, 1915.

The Apparent Cost of Electric Traction.

One of the innumerable unfortunate effects of the war is that it is likely to diminish the amount of capital available for the electrification of railways. At no time is it a simple matter to secure money for a development which involves large sums and retains a somewhat speculative character; therefore, during the period of financial reaction after the war the difficulty is certain to increase. Nevertheless, it should be recognised that the improvement of transport is one of the most important things which fall to be undertaken by a nation which is striving to increase its industrial efficiency. Great Britain has recently had a very vivid object lesson in the effect which high transport charges and limited facilities can have upon the price of almost every commodity. The direct corollary—that it is economical to spend money in cheapening and extending rapid transport—is one which should impress itself upon the Government and upon financial and industrial authorities. The duty of the electrical engineer in such circumstances is to keep clearly in the forefront the conviction that electricity provides the ultimate solution of the transport problem. There is a persistent tendency among vested interests to draw a line beyond which the electrical solution cannot be applied with advantage. In the course of a recent address to the students of the Institution of Electrical Engineers, Mr. C. H. Merz pointed out that electric traction had so far been applied almost exclusively—in this country at least—to cases where the traffic demands grew beyond the limit which could be met by the fullest steam schedule. Electrification was forced upon the companies in order to provide an increased service, with the result that our experience of electric railway traction was mainly in the handling of heavy rush traffic with frequent stops. This is the most costly form of traffic, and with the great increase in volume it has made the expense of electric traction appear very heavy. The point emphasised by Mr. Merz was this appearance of heavy cost told against the prospects of electric traction under more normal conditions. In order to do electric traction justice, it will be necessary to approach the problem of applying it in other directions with a mind free from the prepossessions suggested by early experience under exceptional circumstances. The important factor in any proposal for electrification is the density of traffic. Shortness of line is not important; and although frequent stops are characteristic of existing electric railways, they tell against electrical costs per ton-mile. He averred that examination of the real data—not those derived from suburban passenger working—shows that goods traffic can be done much more cheaply by electricity than by steam. This will probably appear an extravagant claim to the engineer trained in the tradition of steam, and also habituated to the notion that the field of electricity is that of a passenger railway run like an exaggerated tramway. The question, however, is on the eve of practical decision. The electric goods locomotives built for the North Eastern Railway will provide the type of information needed to round off Mr. Merz's argument to a satisfactory conclusion.

High-Tension Direct-Current Traction.

The description which is given in this issue of a scheme on a very large scale of high-tension direct-current electrification of a trunk line railway should also have the particular attention of all concerned in electric traction. Within the last year or two the direct-current system, even for long lines, appears to be gaining in favour as

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compared with the alternating-current system, and our own anticipations in the matter are being justified. The scheme of the Chicago, Milwaukee, and St. Paul Railway, involving the electrification of hundreds of miles of route through mountain territory, is an ambitious one; and, indeed, is the biggest thing of the sort ever attempted. Greater economy of operation and greater efficiency, as compared with steam traction, are the ends in view. The direct-current is to be used at a pressure of 3,000 volts, which is the highest yet employed in America. The only high-tension direct-current railway in this country is the short experimental line of the Lancashire and Yorkshire Railway Company from Bury to Holcombe Brook, where a working pressure of no less than 3,500 volts is used. The great economy which has been achieved on the Butte and Anaconda Railway with direct-current at a pressure of 2,400 volts seems to have been a strong motive in determining the system for the Chicago and St. Paul. Serious mountain gradients have to be dealt with and exceptionally heavy trains will be hauled. The electric locomotives, each capable of developing 3,440 H.P., are said to be the most powerful, whether steam or electric, in the world. This is not an electrification for the purpose of running an enormous passenger business over a short distance by very frequent trains. It is a trunk line job with infrequent but very heavy trains which have to be hauled over very great distances. Accordingly, if the scheme is successful it ought to give a great impetus to main-line electrification. In one direction at least it is certain that conditions could hardly be more favourable. Energy is to be bought from an electric power company which by means of its hydro-electric generating stations is able to sell to the railway company at a price of no more than a farthing and a half per unit.

London Traffic. The annual report of the London Traffic Branch of the Board of Trade, an abstract of which appears in our present issue, contains as usual a great mass of highly interesting information, but it presents no unusual or surprising features. When the Government, instead of appointing a London Traffic Board with wide powers as recommended by the Royal Commission on London Traffic now nearly ten years ago, established a London Traffic Branch of the Board of Trade with no powers at all except to keep up to date the information gleaned by the Royal Commission, we strongly criticised that action. Repeatedly since then we have urged the necessity of constituting a Traffic Board, and in recent years the London County Council have taken the same course. It has been of no avail, and as time passes the fatuity of the Government in the matter only becomes the more conspicuous. The Traffic Branch may make the most excellent recommendations, but they have no powers, and nothing is done. For example, the routes for new arterial roads are being closed up by suburban building, and trouble and expense for the future are being steadily incubated. Tramway dead ends are not being abolished by linking lines, because the veto of the borough councils has not been abolished. Comprehensive schemes of road development and of tramway and railway connections are not being planned and carried out because there is nobody empowered to do so. These are only examples. The wonder is that chaos in London traffic is not worse than it actually is. As for the present report, we see once more how local travel in London is developing, and to a degree far more rapid than the growth of the population. We have now got up to 271 journeys per head of the population in 1913, as compared with 145 in 1903. Omnibus traffic has continued to grow more rapidly than that on tramways, chiefly because tramways are not allowed to be extended, while omnibuses can go where they please. Omnibuses continue to be the most dangerous form of traffic, while tramcars remain the safest among all power-driven vehicles. Other matters of interest, including especially the total volume of traffic on the streets, can best be appreciated by a study of the details given in this issue. They are well worth the attention, not only of those professionally concerned, but of every intelligent citizen.

TRAMWAYS IN GERMANY. According to published records there were 288 German tramways on March 31, 1913, with a total length of 3,116 miles Of these 155 were operated and owned by private companies, and 133 were operated under public ownership. The mileage was distributed as follows: Rhine Province, 783 miles; Westphalia, 332 miles; Province of Brandenburgh, including Berlin, 274 miles; Saxony, 234 miles; Bavaria, 116 miles; Alsace-Lorraine, 83 miles; Grand Duchy of Baden, 81 miles; distributed through other parts of the empire, 1,161. While in 1901 there were 101 miles of horse-car lines, in 1912 the number had decreased to 25 miles. In 1901 there were 83 miles of steam-car lines, and in 1912 only 44 miles.

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GROWTH AND CHARACTERISTICS OF LONDON TRAFFIC.

Board of Trade Report.

The seventh annual report of the London Traffic Branch of the Board of Trade (dated 1914) was issued on January 22, and in accordance with its purpose it brings up to date the information given by the Royal Commission on London Traffic in 1905. It appears from a prefatory note dated October 15 last that the recommendations for the improvement of arterial roads in the Metropolitan area, which were published in the reports for 1910 and 1911, were being subjected to close scrutiny by sectional conferences then being held at the Local Government Board. A short account is given of their proceedings, and it would appear that the published road scheme, apart from the financial aspect, meets with a very fair amount of general support. The report itself extends to some 30 folio pages, is supplemented by elaborate statistical appendices in tabular form, and is illustrated by 10 highly-interesting diagrams, the majority of which are reproduced here. As a rule the statistical information does not extend later than the end of the year 1913.

Local Passengers in Greater London.

The preliminary section of the report opens with a table brought down to 1913 inclusive, showing the stupendous number of passengers carried in the last 10 years by local railways, tramways, and omnibuses. One of the most interesting features in the table (here given) is the enormous growth in the number of journeys per head of the population, thus showing how travelling increases as the facilities for it are developed.

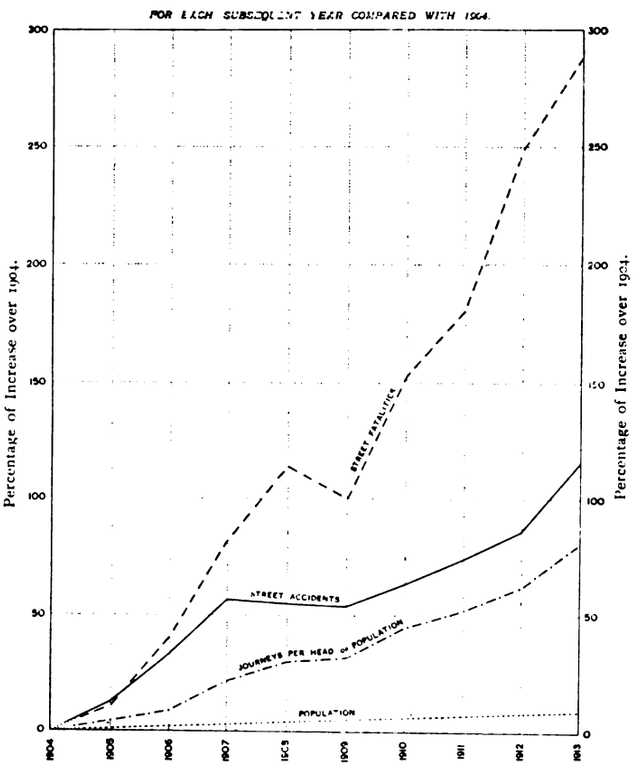

Fig. 2.—Percentages of Increase in Population, Journeys per Head, and Street Accidents as Compared with 1904.

Number of Passengers Carried by	Railway (Local Companies).	Tramway (Approximate).	Omnibus	Total (Approximate).	Estimated Population of Greater London.	Number of Journeys per Head.
Year 1903	290,722,680	394,356,531	287,386,471	972,465,682	6,710,272	144·9
,, 1904	298,638,750	431,813,839	288,965,214	1,019,417,803	6,775,645	150·5
,, 1905	305,052,495	477,944,684	290,665,051	1,073,662,230	6,841,651	157·0
,, 1906	329,521,648	508,700,269	291,563,048	1,129,784,965	6,908,298	163·5
,, 1907	356,233,666	589,745,792	330,000,000*	1,275,979,458	6,975,593	182·9
,, 1908	399,666,339	636,009,090	340,000,000*	1,375,675,429	7,043,540	195·3
,, 1909	410,744,610	687,138,908	311,000,000*	1,408,883,518	7,112,145	198·1
,, 1910	425,271,861	763,797,856	377,207,555	1,566,277,272	7,181,415	218·1
,, 1911	436,498,785	821,819,741	400,628,487	1,658,947,013	7,251,358	228·8
,, 1912	436,492,548	797,487,581	551,622,398	1,785,602,527	7,321,978	243·9
,, 1913	462,019,537†	811,397,317	733,931,201	2,007,348,055	7,393,280	271·5

* Number of passengers estimated on basis of receipts: the figures are believed to be underestimated.
The figures of estimated population of Greater London have been recomputed on the basis of the revised census statistics.
† Figures compiled on basis of Railway Companies (Accounts and Returns) Act, 1911, and not strictly comparable with those for previous years.

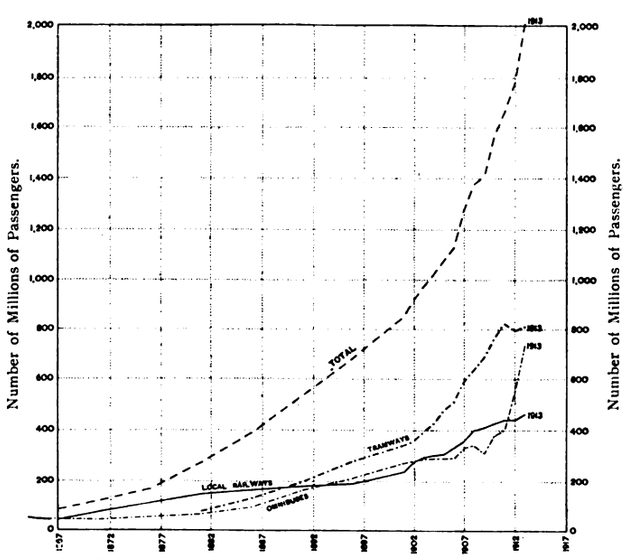

Fig. 1.—Passengers Carried on Local Railways, Tramways, and Omnibuses in Greater London—1867-1913.

This table of the number of passengers carried by public conveyances shows that the importance of the roads is growing each year. The percentage of journeys by road as compared with those by rail shows a steady increase during the last five years.

In 1909 ..	60	per cent. by road,		40	per cent. by rail.	
,, 1910 ..	63	,,	,,	37	,,	,,
,, 1911 ..	64	,,	,,	36	,,	,,
,, 1912 ..	66	,,	,,	34	,,	,,
,, 1913 ..	68	,,	,,	32	,,	,,

Horse-drawn vehicles continue to be supplanted with remarkable rapidity by those mechanically propelled. Except among private carriages, where the horse may retain its popularity a little longer, the extinction of the horse for passenger purposes seems now almost in sight.

Arterial Roads and Town Planning.

Within the last year or so some of the lines originally selected for proposed new roads have become blocked

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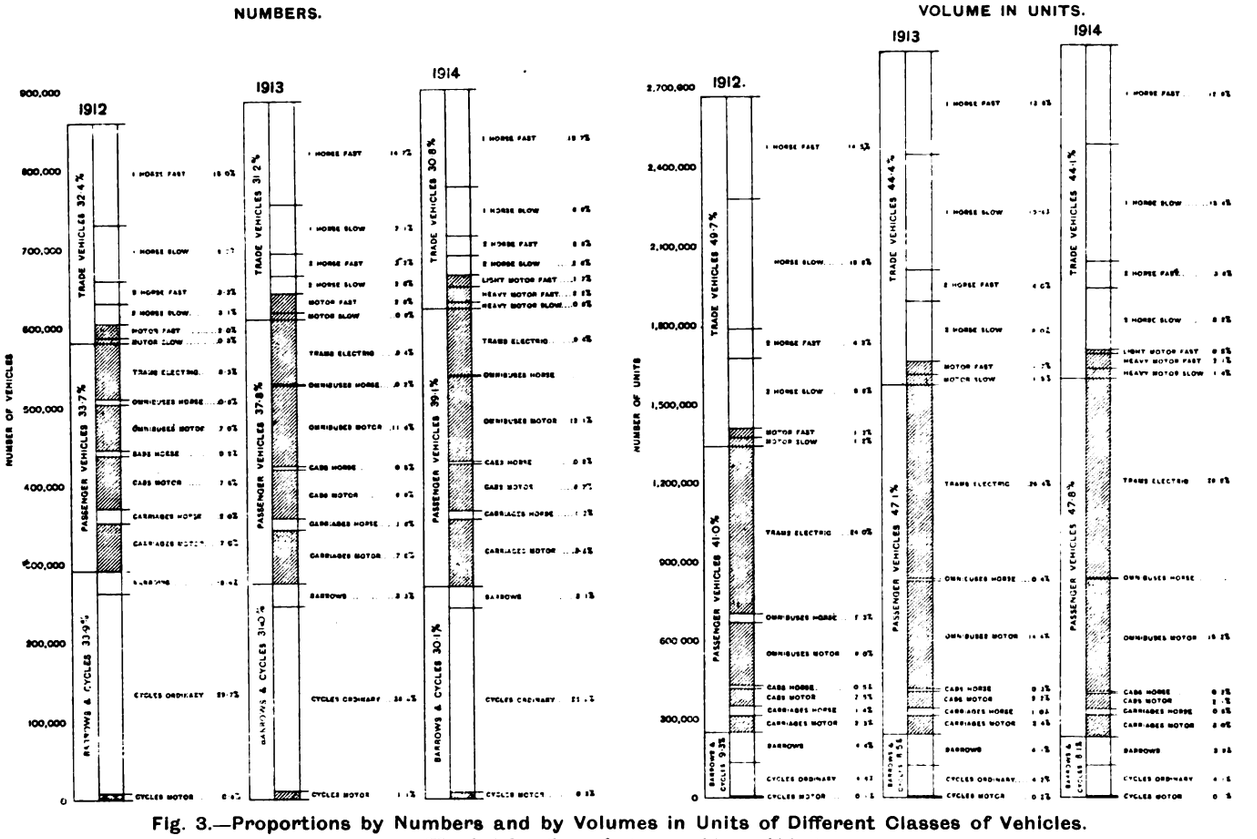

Fig. 3.—Proportions by Numbers and by Volumes in Units of Different Classes of Vehicles.
(The shaded portions refer to power-driven vehicles.)

by building development. Traffic continues to increase, particularly on the outskirts, and the inadequacy of the main arterial roads is becoming more marked each year. The total horse and motor vehicles enumerated at 84 points, fairly distributed all over London, show an increase in numbers for 1914 of 19·2 per cent. over those for 1911. The fact that estate development has already blocked some of the selected routes should convey a serious warning that there is no time to lose in dealing with other sections of roads on the outskirts.

Traffic Censuses.

In view of the great increase in the number of motor omnibuses and the delay to other traffic caused by their drawing in towards the pavement and stopping at intervals, it has been found desirable to modify the traffic units adopted in 1910, under which every

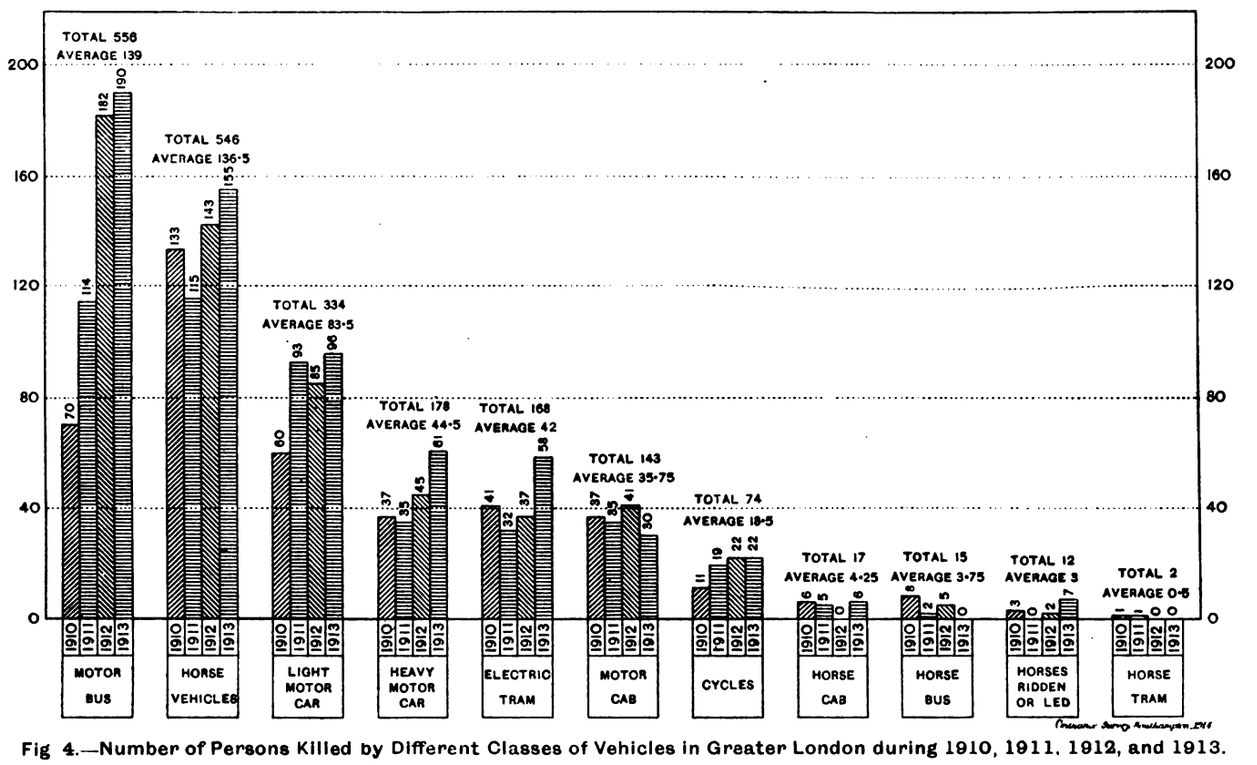

Fig 4.—Number of Persons Killed by Different Classes of Vehicles in Greater London during 1910, 1911, 1912, and 1913.

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type of vehicle was given a coefficient. The coefficient is based on the size, speed, and flexibility of the vehicle, and on the basis of the new traffic units the census returns of previous years have been recalculated. Discussing the characteristics of the various classes of vehicles in connection with the fixing of the coefficients, it is pointed out that the "two (or more) horse slow" trade vehicle is the most obstructive on the road. The electric tramcar comes next, but in deciding on its coefficient one is placed in the difficulty that while for purposes of computation a fixed figure is required, in reality it varies considerably in different parts of London according to the width of road and the traffic conditions of the street. No other class of vehicle is so much affected by these outside considerations.

The revised scale of units is as follows:

Trade Vehicles.			Passenger Vehicles.		
One horse ..	fast .. 3		Electric tramway		9
	slow .. 7		Omnibus ..	horse ..	5
Two horse ..	fast .. 4			motor ..	4
	slow .. 10		Cabs	horse ..	2
Light motor ..	fast .. 1			motor ..	1
Heavy motor ..	fast .. 3		Carriages ..	horse ..	2
	slow .. 5			motor ..	1
Barrows	.. ..	4			
Cycles	.. ..	½			

The results of traffic censuses for three years taken at 93 points are illustrated in the diagram (Fig. 3). Both the number of vehicles and their volume in units on the above scale are shown. The observations show that in 1914 only 4 per cent. of the passenger vehicles were horse-drawn, compared with 6 per cent. in 1913, 11 per cent. in 1912, and 13 per cent. in 1911, and that in 1914 85 per cent. of the trade vehicles were horse-drawn, compared with 88 per cent. in 1913, 91 per cent. in 1912, and 94 per cent. in 1911. The total number of trade vehicles enumerated is much the same as last year—the increase being only ·1 per cent., while the volume shows a decrease of ·01 per cent. Taking the trade and passenger vehicles together, the total of the horse and motor vehicles increased 2·9 per cent. in number, and 1·2 per cent. in volume. The abnormal rise last year in the number of motor omnibuses and tramcars enumerated, followed this year by small increases of 5·9 per cent. and 1·1 per cent. respectively, gives the impression that a practical limit may soon be reached. Between them, in numbers, these large public conveyances form 20 per cent. of all the vehicles enumerated, while in volume they account for about 41 per cent. of all the traffic on the main routes.

Although the substitution of motor for horse-drawn vehicles should in theory tend to lessen congestion, yet in practice the loss of time involved by the intermingling of fast and slow traffic in any congested street goes a long way to neutralise the advantages of the motor, and even tends to check the pace at which the conversion of horse to motor progresses in the commercial world.

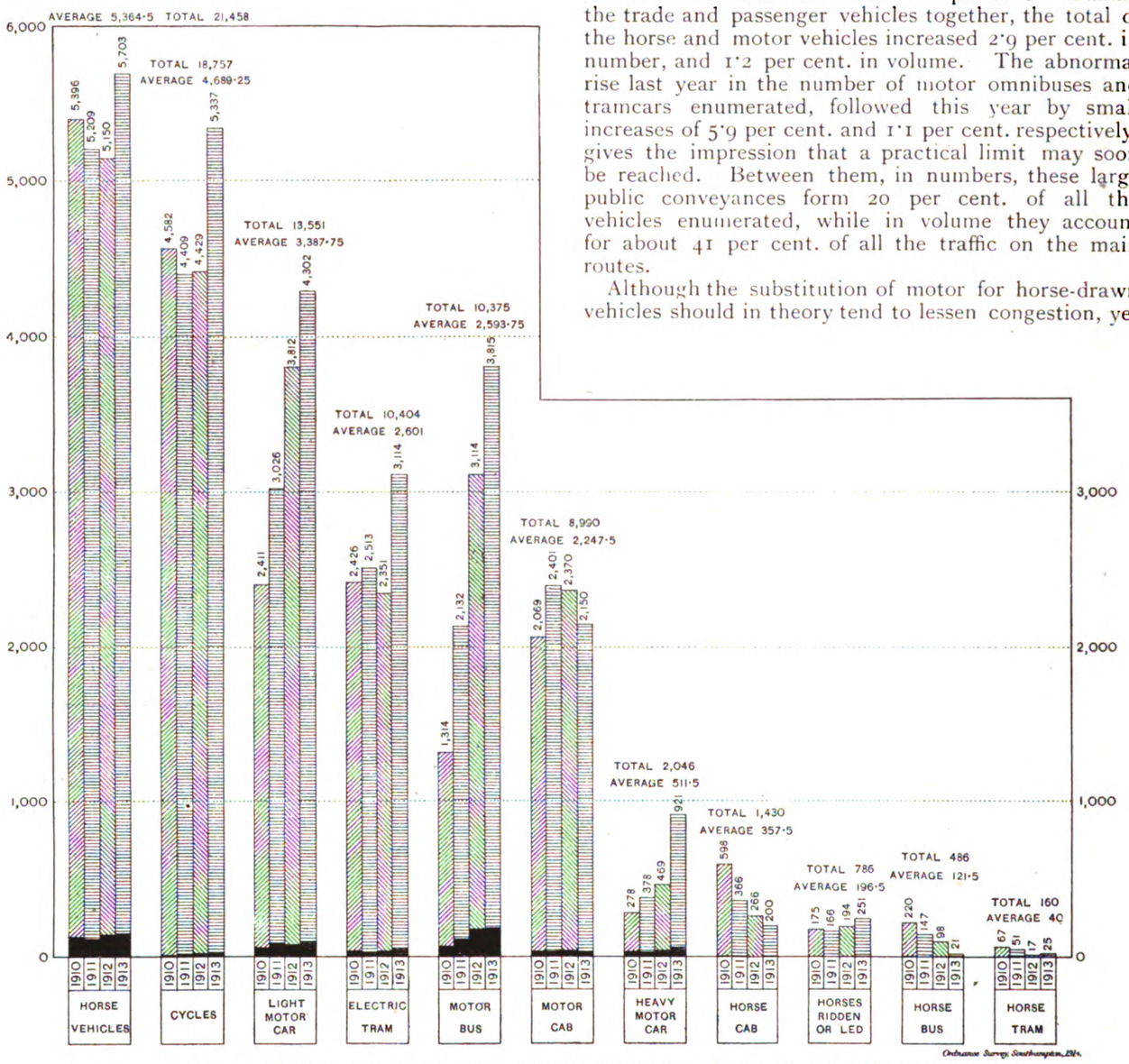

Fig. 5.—Number of Accidents (Killed and Injured) by Different Classes of Vehicles.

Public Carriages.

The following table shows the number of licences issued by the Commissioner of Police for the Metropolis for cabs, omnibuses, and tramcars in the 11 years from 1903 to 1913:

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NUMBERS OF CABS, OMNIBUSES, AND TRAMCARS.—1903-1913.

Year.	Two-wheeled Cabs.	Four-wheeled Cabs.			Omnibuses.			Tramway Cars.			Total of all Vehicles.
		Animal.	Mechanical.	Total.	Animal.	Mechanical.	Total.	Animal.	Electrical.	Total.	
1903	7,499	3,905	1	11,405	3,623	13	3,636	1,143	576	1,719	16,760
1904	7,137	3,920	2	11,059	3,551	31	3,582	928	810	1,738	16,379
1905	6,996	3,935	19	10,950	3,484	241	3,725	786	1,124	1,910	16,585
1906	6,648	3,844	96	10,588	2,964	783	3,747	905	1,396	2,301	16,636
1907	5,952	3,866	723	10,541	2,557	1,205	3,762	404	1,768	2,172	16,475
1908	4,826	3,649	2,805	11,280	2,155	1,133	3,288	323	2,003	2,326	16,894
1909	3,299	3,263	3,956	10,518	1,771	1,180	2,951	239	2,198	2,437	15,906
1910	2,003	2,721	6,397	11,121	1,103	1,200	2,303	120	2,411	2,531	15,955
1911	1,054	2,293	7,626	10,973	786	1,962	2,748	90	2,665	2,755	16,476
1912	567	1,818	7,969	10,354	376	2,908	3,284	60	2,859	2,919	16,557
1913	386	1,547	8,387	10,320	142	3,522	3,664	40	2,786	2,826	16,810

The figures do not necessarily represent the number of vehicles in service, as some may be licensed more than once in the same year on change of ownership, and licensed vehicles may not all be taken out, but they serve to indicate the changes that have taken place, especially in the substitution of mechanical for horse-drawn vehicles.

OMNIBUSES.

At the end of 1913 there were only 28 more omnibuses licensed than in 1903, at the advent of the motor omnibuses. When it is realised that the motor omnibus covers nearly double the daily mileage of the old horse omnibus, it will be seen what an enormous increase has taken place in this method of road transport. The horse omnibus may now be said almost to have disappeared from the streets of London, all the more important routes being worked by motor omnibuses.

The number of passengers carried by omnibuses in 1913 amounted to 733,931,201 as compared with 551,622,398 in 1912, an increase of over 182,300,000. Omnibus services now extend over a great mileage, the length of road traversed by the London General Omnibus Company and the associated companies being 195 miles in 1912, 406 miles in 1913, and in June, 1914, 528 miles.

Through bookings have been instituted and are now in operation between various omnibus, train, and tramway services.

TRAMWAYS.

The mileage of lines open for traffic, and the number of passengers carried by tramways in Greater London for the 11 years 1903 to 1913, are given in the following table; the figures are made up to March 31 in each year, except those relating to the passenger traffic on tramways owned by companies, which are made up to December 31:

MILEAGE OF TRAMWAY LINES AND TRAMWAY PASSENGER TRAFFIC IN GREATER LONDON.

Year.	Length of Line Open.						Passengers Carried.		
	Within the County of London.		In Outer London.		In Greater London.		Within the County of London.	In Outer London.	In Greater London.
	Street Miles.	Single Track Miles.	Street Miles.	Single Track Miles.	Street Miles.	Single Track Miles.			
1903	115·18	205·92	73·74	121·55	188·92	327·47	299,209,364	95,147,167	394,356,531
1904	119·35	213·08	103·66	177·77	223·01	390·85	311,691,157	120,122,682	431,813,839
1905	117·73	213·66	131·37	220·33	249·10	433·99	324,854,380	153,090,304	477,944,684
1906	117·59	219·04	169·31	303·51	286·90	522·55	316,986,310 (*a*)	191,713,959	508,700,269
1907	126·80	234·12	177·13	319·51	303·93	553·63	372,515,754	217,230,038	589,745,792
1908	131·57	248·53	179·93	323·81	311·50	572·34	412,913,881	222,195,240	635,109,121
1909	136·47	257·70	189·78	343·61	326·25	601·31	451,439,216 (*b*)	235,891,425	687,330,641
1910	146·90	273·93	192·68	358·75	339·58	632·68	504,715,326 (*b*)	359,082,530	763,797,856
1911	149·75	279·52	195·16	363·81	344·91	643·33	533,440,235 (*b*)	288,379,506	821,819,741
1912	157·74	289·15	195·65	364·79	353·39	653·94	512,652,653 (*b*)	284,834,928	797,487,581
1913	157·86	300·72	195·65	364·79	353·51	655·94	522,952,640 (*b*)	288,444,677	811,397,317

(*a*) Falling off due to dislocation of traffic during electrification of London County Council Northern Tramways.
(*b*) Passengers carried by the London County Council only.

Particulars are given as to new London County Council lines authorised in 1913 and 1914, the financial results of the working of the County Council's system in recent years, through running, through booking, the liberty to run trailer cars, etc. These matters are already well known.

RAILWAYS.

The total length of railways open for passenger traffic in Greater London at the end of 1913 was 669·2 miles. The number of railway stations, exclusive of halts, was 626. In the following table a comparison is made of the mileage and the number of stations for the years 1903, 1907, 1912, and 1913, with the addition of the proportions of mileage and stations to population and area.

In Greater London.	1903.	1907.	1912.	1913.
Length in route miles	607·3	667·4	668·8	669·2
Length per square mile	·88	·96	·97	·97
Population per route mile ..	11,049	10,452	10,842	10,836
No. of stations	538	611	623	626
No. of stations per square mile ..	·78	·88	·90	·90
No. of inhabitants per station ..	12,473	11,417	11,639	11,584

Details are given of the new railway works completed and in progress in 1913, regarding the London Railway Bills in Parliament in 1914, and as to railway electrification schemes in progress.

COMPETITION.

The competition between road and railway undertakings continued acute throughout the year. The motor omnibus routes are extending further into the outskirts of the Metropolis, even to such distances as St. Albans and Farnborough. Tramway extension is slower and is confined in most instances to the linking up of dead ends to facilitate through running, and, within the county, to extensions of lines to traffic points. One difficulty of dealing with motor omnibus competition is that a line of omnibuses may be established on one part of a railway system one week, and

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taken off shortly afterwards. Moreover, motor omnibuses are not bound to a route like lines of rails—they can alter their routes as they like in order to suit their purpose. The effect may be that when a railway company has reduced its fares so as to meet the omnibus competition, the omnibus company can remove those services and put them on at another part of the railway system. This is a matter which railways having a large suburban traffic will have to consider without undue delay, and probably electrification may prove to be the solution in general. Surface competition has also strongly affected underground electric railway traffic.

Accidents.

Under this heading the report first gives statistics of railway accidents along with details as to the more serious of them. In reference to street accidents, these are still on the increase. Against this must be set the fact that people travel much more than they used to. In 1904 the journeys per head of the population were only 150·5, in 1913 they were 271·5, an increase of 80·7 per cent. The corresponding totals of street accidents were 11,967 in 1904, and 25,839 in 1913, an increase of 115·9 per cent. In the diagram (Fig. 5) these rates of increase are illustrated graphically. Fatalities have, however, increased much more rapidly, and there can be no doubt that this is largely due to the multiplication of motor vehicles. On the average of the last four years, the motor vehicle is twice as likely to cause accident as the horse vehicle, while, in the case of causing death, the proportion is even more marked, the fatal effect of motor vehicles, with the exception of the electric tram, being up to three and four times as great as that of horse vehicles.

The setting up of a large number of additional refuges, and the compulsory fitting of guards to the side wheels of all motor omnibuses have already done much, and will do more to check the rate of increase in accidents. It would also be advisable that the heavy commercial motor cars now in use should have similar guards fitted, but in view of the fact that the average of the three years 1910-12 showed that 55 per cent. of the fatalities were due to the inadvertence of the pedestrian, the best hope of further improvement

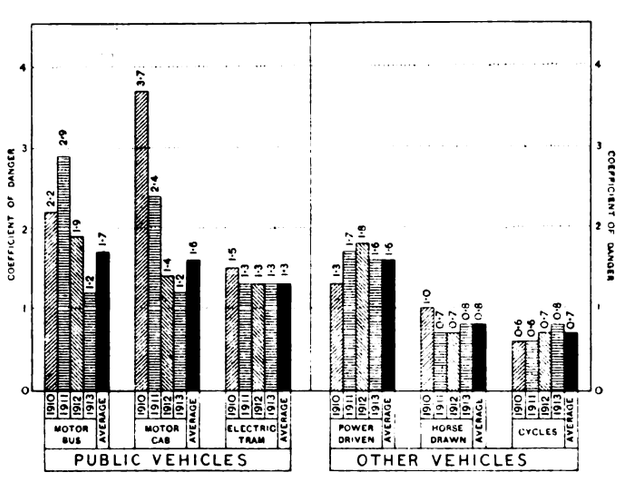

Fig. 6.—Comparative Danger of Vehicles.

seems to lie with the pedestrian himself, and there is no doubt that the average person is now much more careful than he used to be. It is to be hoped, too, that the experience and standard of drivers is also improving. The details as to growth of accidents and the proportions caused by the different classes of vehicles may be gathered from the diagrams (Figs. 4 and 5).

Three per cent. of the accidents due to power-driven vehicles proved fatal, and $2\frac{2}{5}$ per cent. in the case of horse-drawn vehicles. That this is largely due to weight is shown by the relatively high percentage of accidents in the case of the heavy motor car and the motor 'bus, with 8·7 and 5·4 per cent. respectively. On the other hand the electric tram, the heaviest vehicle of all, with its low percentage of 1·6, is an exception, and this is

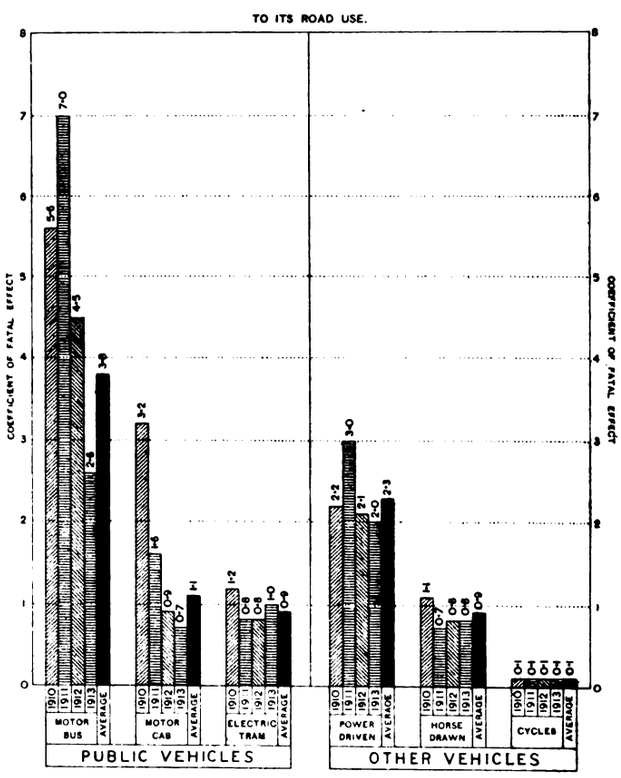

Fig. 7.—Comparative Fatal Effect of Different Vehicles.

accounted for by the high efficiency of the life-guard which is fitted to these vehicles.

The motor 'bus still heads the list with the largest number of deaths caused, 556 in the four years, but in proportion to the work done by these vehicles, their fatal effect has largely decreased.

Comparative Danger of Different Vehicles.

In investigating this subject it is not sufficient to take the actual number of accidents; consideration must also be given to the number of vehicles in each class and to the amount of mileage run. Such a comparison is worked out in a table appended to the report and shown graphically in diagrams, the latter of which are here reproduced (Figs. 6 and 7).

By a combination of the figures a factor may be obtained which would represent a fair measure of relative danger. Investigations on these lines have been carried out for the four years 1910-1913, and the results are illustrated in the diagrams. The percentage of traffic does not take into consideration the passengers carried. Factors are arrived at for each class which fairly represent its capacity for causing both accidents and fatalities. For example, if in any one year 10 per cent. of the total traffic counted consists of a certain type of vehicle, which causes 20 per cent. of the total accidents and 30 per cent. of the total fatalities, its factor of accident or "coefficient of danger" for that year would be two and its "coefficient of fatal effect" three.

It thus appears that so far as causing accidents are concerned, power-driven vehicles on the average present much the same degree of danger, the motor 'bus being slightly higher than the motor cab and other motor vehicles, and the electric tram the lowest.

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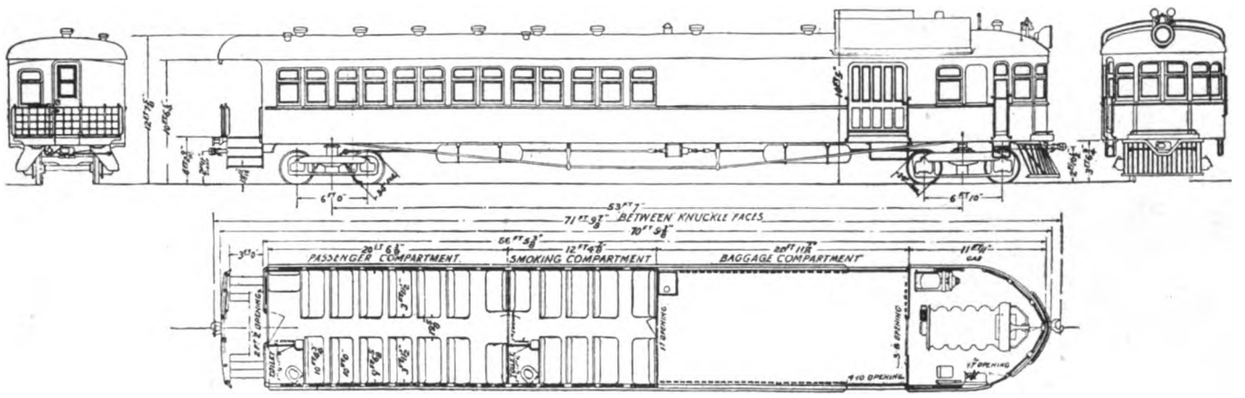
PETROL-ELECTRIC RAIL MOTOR CARS.

Petrol-electric motor cars for railway service continue to grow in popularity with American railway managers. A large number are in service on branch lines, and they are also used to supplement the regular train services on routes of heavier traffic. The American General Electric Company have for some time devoted special attention to this branch of work; and they have used the advertisement pages of American railway papers in a very effective way, with the result that railway companies in all parts of the United States have had the advantages of this type of rail motor set before them.



Petrol-Electric Car for Spokane, Portland, and Seattle Railway.

Good salesmanship has, no doubt, been a useful factor in crystallising the effect of the newspaper introduction, and the results obtained from the first cars have apparently supplied the fitting climax of practical demonstration.

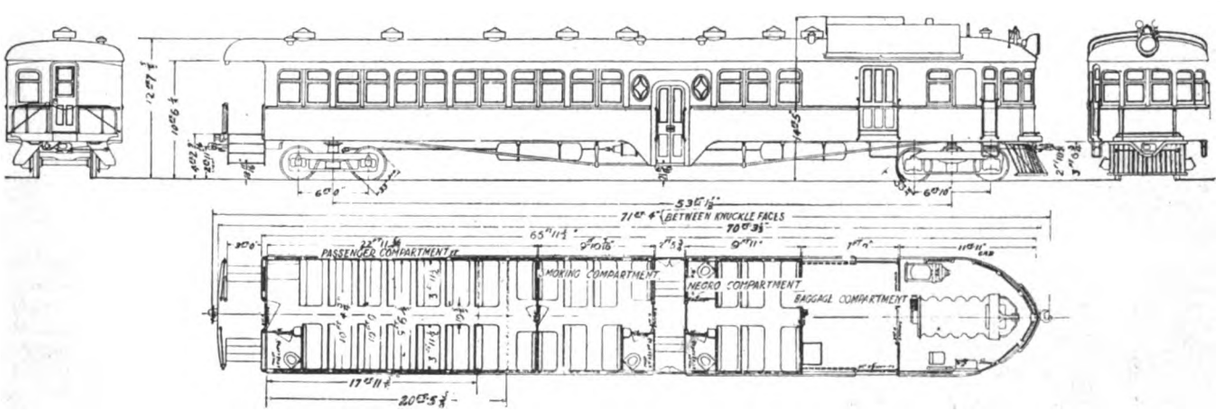
Some of the latest cars of the type are here illustrated. They are much alike in equipment, but the designs of the body show interesting differences. The first car was built by the General Electric Company at their works in Schenectady, New York, for the Spokane, Portland, and Seattle Railway. The car will be required to haul regularly one 25-ton trail car seating 60 passengers, and it is to be capable of drawing a second trail car when necessary. The schedules of trains composed of the motor car and two trailers will be considerably more rapid than that of the steam trains it will replace. The maximum grade on this section of the railway is one-half of one per cent., extending over a distance of about three miles; but, in general, the track follows the Columbia River grade and is nearly level.

The details of construction conform in general to those of the standard cars manufactured by the American General Electric Company, but the luggage compartment is about twice the usual length in order to transport the large quantity of parcels handled, particularly the heavy shipments during the fruit season.

The dimensions are 71 ft. 9⅞ in. over buffers by 10 ft. 6⅜ in. wide over all. The weight is approximately 51 tons, and the car has a seating capacity for 68 passengers. The interior is partitioned into four compartments. The cab in front, containing the power apparatus, measures 11 ft. 11 in. long; next is the luggage room, 20 ft. 10⅞ in. long; then the smoking section, 12 ft. 6 in. long; and the passenger compartment, 20 ft. 5¾ in. long.

The car is equipped with two GE-205, 600-1,200 volt, box frame, oil-lubricated, series, commutating pole railway motors having a total of 200-H.P. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. They are insulated for 1,200 volts so that they may be interchanged, if desired, with the motor equipments on the cars of the Oregon Electric Railway, which operates on the 1,200-volt system. The generating unit consists of an 8-cylinder, 4-cycle petrol engine of the "V" type, direct-connected to a 600-volt, commutating pole electric generator, designed to meet the special conditions the service demands.

The body of the car is of all-steel construction, except the seats and interior finish. A platform entrance is provided at the rear of the car. The trucks are of the heavy spring-bolster type with elliptic bolster and coil equaliser springs.



Petrol-Electric Car for Illinois Central Railway.

The car shown in the second illustration is one of four which have been built by the same company for the Illinois Central Railway. These cars are known as the CRE.-70-B-8 type, and conform to the standard style of car of the General Electric Company. They measure 71 ft. 4 in. over bumpers by 10 ft. 6¾ in. wide over all, weigh approximately 51·5 tons, seat 86 passengers, and are each equipped with two GE-205, 600-volt, box frame, oil-lubricated, commutating pole

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railway motors having a total of 200-H.P. capacity. The motors are mounted with nose suspension directly on the axles of the forward truck. In all other respects the generating unit is similar to that of the car already described.

The interior of the cars is partitioned into five compartments. The cab in front, containing the power plant apparatus, measures 11 ft. 11 in. long; next is the baggage room, 8 ft. long; then the coloured passenger compartment, 9 ft. 10⅞ in. long; the smoking section, 9 ft. 10 in. long; and the passenger compartment, 22 ft. 11⅞ in. long. The track is the standard gauge.

The body of the cars is of all-steel construction, except the seats and interior finish. Centre vestibules with side entrances run between the passenger and smoking and cooking and "coloured" passenger compartments, as the sections for the use of negroes are described. The entrance is at the rear. The trucks are of the same pattern as those for the car first described.

BOARD OF TRADE TRAMWAY RETURN.

ENORMOUS FIGURES.

There was issued in the end of January the annual Board of Trade return of street and road tramways and light railways in the United Kingdom, together with similar particulars relating to trackless trolley undertakings. The figures come down to December 31, 1913, in respect of companies, and to March 31, 1914, in respect of local authorities.

Many of the important totals of the detail statistics are concentrated in the tables which are here reproduced, but a few additional facts of interest are to be gleaned. The number of passenger journeys in the year 1913-14 was equal to about 74 times the estimated population of the United Kingdom. Of the total of 1,848 miles of line owned by local authorities, 1,640 miles were worked by those authorities or (in a few cases) by other local authorities leasing from them, and the remaining 208 miles by leasing companies.

The net receipts of local authorities working tramway undertakings amounted to £4,071,610 on the year's traffic. £1,218,299 was required to pay interest on capital and £120,039 for rent of leased lines, £1,371,263 was applied towards the reduction of tramway debt, and £589,886 in relief of rates, while £711,217 was carried to reserve and renewal funds. In the case of three local authorities and five companies the returns show an excess of working expenditure over gross receipts. In 26 cases it was necessary to seek aid from rates to meet part of the charges for the year. The total amount thus obtained was £62,000, as compared with £64,988 in the previous year.

In regard to trackless trolley undertakings, of the 26 authorised 21 belong to local authorities and five to companies. Altogether, 131 miles have been authorised, and of this length 21 miles were worked by the owning local authorities. No trackless trolley routes were worked by companies during the year.

SOME GRAND TOTALS FOR UNITED KINGDOM.

	1913-14.	1912-13.
Total capital expended	£80,977,838	£79,359,758
Number of horses	956	1,273
Number of locomotives	29	30
Number of cars:		
Electric	13,196	12,773
Non-electric	462	487
Board of Trade units	629,862,019	586,106,417
Gross receipts	£15,787,877	£14,972,919
Working expenditure	£10,159,556	£9,384,798
Net receipts	£5,628,321	£5,588,121
Interest or dividend	£2,101,602	£2,072,917
Repayment of debt or sinking fund ..	£1,395,086	£1,319,914

LENGTHS WORKED BY VARIOUS METHODS OF TRACTION.

Method of Traction.	England and Wales.		Scotland.		Ireland.		Total.	
	Mls.	Chs.	Mls.	Chs.	Mls.	Chs.	Mls.	Chs.
Electric	2,170	5	288	76	136	21	2,595	22
Steam	12	30	—		29	46	41	76
Cable	1	49	23	76	—		25	45
Petrol motors	1	15	—		—		1	15
Gas motors	4	2	—		—		4	2
Horse	23	43	4	28	6	75	34	66
Total (tramways) ..	2,212	64	317	20	172	62	2,702	66
Trackless trolley ..	19	32	1	20	—		20	52

‡ Worked early part of year only.

LIVERPOOL TRAMWAYS INSPECTION.

On Tuesday, January 19, the Lord Mayor of Liverpool (Mr. J. E. Rayner) accompanied the members of the Tramways and Electric Lighting Committee, and Mr. C. W. Mallins, A.I.E.E., general manager, Liverpool Corporation Tramways, on a visit of inspection to the offices, car works, and depots of the tramways undertaking. After meeting at the chief offices in Hatton Garden, where considerable interest was shown in the accounting, checking, and reporting systems, the company was conveyed by autocars and special motor 'buses to the car works in Lambeth Road.

At the car works, as described elsewhere in this issue, a striking improvement has been effected during the last eight months, a new gallery, 18 ft. wide, having been built along one side of the building. Over two tracks on this side of the works a travelling crane of 15 tons capacity has been erected. Attention was directed to a new car with revolving seats on both decks. The swivel chairs are similar to those used in dining saloons on board ship, and the system of arranging them in pairs slightly staggered, instead of being level, easily permits a passenger by the window to gain or leave his seat without disturbing the passenger seated next the corridor.

Walton car depot was then visited, and here the Lord Mayor opened a rifle range, which has been provided at the end of one of the pits. The various arrangements at this depot for the comfort and entertainment of the employees were much admired. These include a bakery, which supplies the other five depots (Smithdown Road, Green Lane, Dingle, Litherland, and Garston), a large social hall for concerts and dancing, and a billiard room. Proceeding to the Dingle depot, the members had some more shooting practice at another rifle range, and visited the Dingle reading and billiard room. Rifle ranges have also been fixed in the pits at the Smithdown Road and Green Lane depots.

After the inspection, the company was entertained at dinner at the Adelphi Hotel by the chairman (Mr. Russell Taylor), who was supported by the Lord Mayor, the deputy-chairman (Alderman Fred Smith, J.P.), and the general manager. In an interesting speech in response to the toast of the evening, Mr. Mallins remarked that, if he were spared till next June, he would have completed 40 years' tramway service. It is difficult to regard such a vigorous personality as a veteran, so it must be presumed that the genial manager became a tramway neophyte at an exceedingly tender age. The remarkable development of the Liverpool traffic and the application of new ideas, which have been the outstanding features of the city's tramways under Mr. Mallins' administration, are some of the fruits of this long and intensely practical experience. Traffic receipts have increased out of all proportion to additional car-mileage—the truest test of efficient administration—while on the mechanical side the recent reorganisation of the car works and several important innovations in tramway car design are notable examples of the general manager's energy and resource. But to revert to Mr. Mallins' speech, it was instructive to learn that in 1875, the year of his novitiate, Liverpool horse cars and 'buses carried 16 million passengers, yielding £155,000 in receipts, as compared with some 146 million passengers, paying roughly three-quarters of a million sterling in fares on the Corporation tramways last year. Forty years ago the minimum car fare was threepence, and a threepenny stage was little more than a third of the present penny stage. The tramways were taken over by the Corporation in 1897, and the first result of the municipalisation was a revision of fares, which made it possible for every section of the community to use the tramways to the fullest extent. The cheapening of fares enabled many of the industrial population to move from the crowded central areas into healthy suburbs. All this was done without any call upon the ratepayers. A large reserve fund has also been built up, and this, Mr. Mallins pointed out, was essential, because the whole transportation system might be revolutionised some day. The revolutionary agent, however, will not, in his opinion, be the motor 'bus, which the general manager regards as a very useful adjunct to the tramway system but with decided limitations. The problems with which the manager and his committee are chiefly concerned at present are traffic congestion in the central area and the speeding up of suburban transit.

York Tramway Extensions.—As reported in a previous issue, Mr. J. W. Pearce, of Doncaster, has been awarded by the York Tramways Committee a contract for the construction of tramways on the Hull Road route. He has also secured the contract for extensions to be carried out at the request of the military authorities. These include the laying of lines from Leeman Monument to the North Eastern Railway goods yard in Leeman Road, and from Fulford Road to the Ordnance Stores. The military authorities requested the Tramways Committee to construct these lines so that the large quantity of stores which have to be dealt with at the present time could be taken direct from the railway goods yard to the Ordnance Stores. The estimated cost of the scheme is £4,700, and the military authorities are willing, if necessary, to advance this sum to the Corporation.

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ACCIDENT ON THE BARNSLEY LIGHT RAILWAYS.

The report of Lieutenant-Colonel P. G. von Donop on the accident which took place on the Barnsley and District Light Railways on December 2 has been issued. The car concerned in the accident started from the Midland Railway Station to run down Eldon Street and got out of control, running away down an incline. It kept to the rails for a distance of about 540 yards, but on reaching a slight right-handed curve ran off the rails, and, travelling across the roadway, came into collision with the wall of a house. Here there was a falling gradient, increasing to 1 in 16 and varying from 1 in 14 to 1 in 25 to the spot where the derailment took place. The car was badly damaged and six passengers were severely injured; two of them subsequently died. The evidence showed that the driver had left the car to speak to the driver of another car, and in his absence his own car started to run down the hill. He went after it, but was unable to overtake it. The conductor at first assumed that the driver had started the car, but when he realised that something was wrong he tried to apply the hand brake and to secure it by means of the clutch, but did not succeed. He then lost his head and jumped off. The car was fitted with a hand brake, rheostatic brake, mechanical slipper brake, and an automatic scotch brake. Colonel Donop's conclusion is that the accident must be mainly attributed to want of care and promptitude on the part of the driver and conductor of the car. The driver knew that his car was standing on a falling gradient, and that it was held only by the hand brake, which was applied from the conductor's end, and which, therefore, could be released from that end: nevertheless, he went away from the car, leaving it in that condition, without warning the conductor that he was doing so, and without applying any brake power at his own end. Further, the car must have started very slowly, and the conductor states that he did not notice its high speed until it had travelled 200 yards. If the driver did not go further away from his car than he himself stated, it seemed inexplicable that he should not have been able to have caught it up and to have tried, at all events, to get it under control. The driver appeared, therefore, to have acted with want of care, and to have shown a lack of promptitude and energy; he must, therefore, be held largely responsible for this accident. As regards the conductor, it was possible that he was misled, by hearing the gong of the Worsley Dale car, into thinking that the gong had been sounded on his own car, but he should not have released his brake until he had made sure that his driver was on the car. When, however, he realised what had happened, he could readily have applied both the hand and the slipper brake from his end; he failed, apparently, without reason, in his attempt to apply the one, and he did not endeavour to apply the other. The conductor certainly failed to rise to the occasion, and he, also, must therefore be held partially responsible for the accident. Colonel Donop adds that a short length of 1 in 50 gradient, which immediately joins a gradient of 1 in 16, is certainly not a suitable spot to select for a tramway terminus. If the terminus cannot be altered, a rule should be made to ensure that the car, when waiting at the terminus, should be held by brakes which are controlled at the driver's end, and that under no circumstances should a driver be permitted to leave his car when it is standing at that terminus.

PETROGRAD AND MOSCOW TRAMWAYS.

The Town Council of Petrograd is taking steps to improve the tramway service of the town. It is observed that as soon as all the tramway sections were transferred to the possession of the town the system of traction was immediately changed to electricity. Compared with the Moscow system, the Petrograd tramways have been much more energetically exploited. Whereas in Moscow only 68 per cent. of all the cars is being operated, the number constantly running in Petrograd is 89 per cent. The total in Moscow is 1,112 cars, and in Petrograd 573 cars. Although the length of line in Moscow is twice that in Petrograd, the number of passengers carried on the two systems has been about equal. The cost of constructing the first two sections of Petrograd tramways was £7,433,000, and the report stated that the cost of working per car-mile is considerably higher in Moscow than in Petrograd, whilst, on the other hand, maintenance expenses for lines and buildings, staff, etc., are higher in Petrograd than in Moscow. The repair system is on a satisfactory basis in Petrograd, but there is need to increase the number of spare parts. The question is now being considered of constructing central workshops. The revenue from the Petrograd tramways, although the fares are lower than in Moscow, is greater than in many Western European centres.

The Royal Commission on Railways.—At a meeting of the Royal Commission on Railways, in London, on January 21, it was decided, in view of existing circumstances, to hold no further meetings for the present.

TRAMWAYS WITH "LIGHTS OUT" AT HULL.

On the afternoon of January 28, the tramway officials of Hull received notice from the military authorities that the whole town was to be in complete darkness all night. This notice put the tramway management in a serious difficulty. To discontinue service was to inconvenience the public to a very great extent, and to maintain the service with "lights out" involved dangerous risks. After anxious consideration, however, the bolder alternative was chosen, and the cars made their journeys throughout the night and before daylight without lights of any kind, the street lamps being extinguished and the house lights reduced to a minimum. "Happily," says our informant, "the nocturnal luminary gave a light, which, though diffused and scanty, was better than none, so that there was no absolute darkness in the streets; but it was a somewhat weird experience to stand in the highway and see the spectral vision of a tramcar emerging out of the vaporous distance and retreating into the same a little further on." On Friday the order was repeated, but at 5-30 p.m. when darkness was settling down, the military authorities gave word that lighting could be resumed. We are glad to state that, notwithstanding the unusual and onerous conditions, no accident of any kind occurred. Mr. W. J. McCombe, the general manager, and his men are to be congratulated upon a fine achievement, though it may be imagined that they do not covet a repetition of the nerve-trying experience.

PORCELAIN OVERHEAD FITTINGS.

A useful catalogue of overhead traction fittings, just issued by Messrs. Geo. W. Green and Company, of Feltham, Middlesex, embraces several novelties and is of considerable value to all engaged in the electric traction industry. The "Glavum" self-lubricating non-fouling trolley head is accorded pride of position in the catalogue, illustrations being given of the head in its normal position and also when the non-fouling properties are in operation. This is a new type of trolley head for which is claimed the important advantage that it cannot possibly foul either the trolley wire or the guard wires; furthermore, as there is an automatic lubricating arrangement whereby oil is forced to the wearing parts from a reservoir in the socket, it has the additional advantage of being able to run for many months without attention. A complete range of line ears are shown, including both the sweated type and mechanical type for round and grooved wire. Line hangers of various designs are also included, as well as strains, bracket arm clips, etc. Trailing frogs and section insulators of the well-known Q-Fel design are well illustrated, as well as their crossings and mechanical frogs, a special feature of the latter being the adjustable frog-pull lever by which the maximum pull can be obtained no matter

Q-Fel Section Insulator.

how awkwardly the poles are situated. The outstanding feature in the design of Q-Fel fittings is the substitution of porcelain reel insulators for the usual moulded insulating material. It is claimed for this system that all insulation troubles are eliminated and that all the advantages of the ordinary moulded type of fittings are obtained at very much less cost. As the reel insulators are lead bushed they do not readily fracture, but in the event of their being broken these fittings have the great advantage that the insulation is renewable at very small cost. Our illustration shows the Q-Fel type of Brooklyns, and clearly indicates some of the patterns in which this fitting is made. The Q-Fel section insulator is the result of many years' experimenting and trials in order to obtain a fitting that actually conforms to the real requirements of a section insulator without the defects which are frequently found in so many overhead systems. Here, again, the earthenware reel forms the insulation, so that there is no possibility of the insulators burning out. The centre portion is renewable, and we understand that the large number now in use are giving perfect satisfaction. Another speciality included in the catalogue is the Q-Fel rail cleaners; these are now in use in all parts of the world, and their value is abundantly proved by the continuous demand that is being made for them.

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FINANCIAL REPORTS AND COMPANY MEETINGS.

The Rio de Janeiro Tramway, Light, and Power Company have announced a quarterly dividend of 1¼ per cent.

The Sao Paulo Tramway, Light, and Power Company have declared a dividend of 2½ per cent. on the capital stock.

Walter Scott, Limited.—An interim dividend has been declared at the rate of 6 per cent. per annum on the preference shares.

Brazilian Traction, Light, and Power Company.—The directors have declared a dividend of 1½ per cent. on the ordinary shares.

The Westinghouse Brake Company, Limited, have paid a dividend at the rate of 20 per cent. per annum for the half-year ended December 31.

Scarborough South Cliff Tramway Company.—At the annual meeting of this company, held on February 6, a dividend of 3 per cent., free of income tax, was declared.

Effect of the War on Berlin Tramways. It is reported that the Greater Berlin Tramways Company, whose dividend for some years past has averaged 10 per cent., has been reduced to 5½ per cent., owing to loss of traffic since the war began.

Wolseley Motors. The directors of the Wolseley Motors, Limited, recommend a dividend of 30 per cent., free of income tax, on the ordinary shares for the year, placing £10,000 to reserve, £32,757 to extinguish goodwill, and carrying £2,501 forward.

Electric and General Investment Company.—The directors have considered it advisable during the continuance of the war to conserve the company's cash resources, and they have not, therefore, paid any interim dividend on the preference or ordinary shares.

British Columbia Electric Railway.—The directors of the British Columbia Electric Railway Company, Limited, have declared the full dividend at the rate of 5 per cent. per annum on the 5 per cent. preferred ordinary stock for the half-year to December 31 last.

City of Buenos Ayres Tramways. The directors of the City of Buenos Ayres Tramways Company (1904), Limited, for the year ended December 31, 1914, recommend a balance dividend of 1s. 3d. per share, making 5 per cent. per annum, that £5,200 be transferred to the general amortisation fund, and £192 carried forward.

Preston Tramways.—The annual report of the Preston Corporation Tramways for the year ended March 25, 1914, shows that the receipts amounted to £45,946, an increase of £2,675. The sum of £1,300 has been contributed to the rates and £2,551 has been added to the reserve fund. The adoption of the transfer ticket system is said to have contributed to the improvement in receipts.

Blackpool and Fleetwood Tramroad Company, Limited.—The directors have recommended a dividend at the rate of 4½ per cent., making 6½ per cent. for the year. The sum of £5,000 is to be carried to depreciation reserve, and £2,500 to the general reserve, leaving £2,977 to be carried forward. A year ago the total distribution for the year was at the rate of 8½ per cent., including a bonus of 2 per cent.

Dublin and Blessington Steam Tramway.—The report of the Dublin and Blessington Steam Tramway Company for the half-year ended December 31, 1914, states that the gross receipts amount to £4,201, the expenses to £4,767, which the directors consider are properly charged against revenue. This shows £566 net loss for the six months, as against a profit of £243 for the corresponding half-year of 1913.

Liverpool Overhead Railway Company.—The directors recommend the payment of a final dividend (for the half-year ended December 31 last) at the rate of 5 per cent. per annum (less income tax) on the preference shares, and 3½ per cent. per annum (less income tax) on the ordinary shares, making, for the year, 5 per cent. on the preference and 3 per cent. on the ordinary shares. The ordinary meeting will be held on February 23.

Traction and Power Securities.—The directors of the Traction and Power Securities Company, Limited, recommend a dividend of 4s. 6d. per share, free of income tax, for the past year; £4,977 from revenue and £305 from realisations were added to the investment reserve, making a total of £205,282; £196,554 of this amount has been applied in writing down investments, leaving a balance of £8,727 to the credit of reserve, carrying £4,622 forward.

Coventry Chain Company. The net profits of this company for the past year were £14,974, and a dividend of 8 per cent. has been declared. Mr. Alick Hill, speaking at the last annual meeting, said there had been an expansion of the foreign business up to the beginning of August, and, although they suffered a very marked loss of trade after the declaration of war, there had been an increase in profits. Business in some departments is active, but there is corresponding slackness in others.

Buenos Ayres Port and City Tramways.—The financial position of the company will not allow of the payment of the interest on the first mortgage debenture stock, which falls due on the 1st prox. The directors are in consultation with a committee—consisting of large holders of this stock and of the first mortgage extension bonds—with a view to promulgating a scheme for the reorganisation of the debenture debt and share capital of the company, and this scheme they hope to be able to put before the stockholders shortly.

Tyneside Tramways Company.—On a profit of £6,184 13s. 6d. and a balance of £1,060 10s. 2d. carried forward from last half-year, the directors recommend appropriation as follows: Dividend of 5 per cent. on preference shares, £601; dividend on ordinary shares at 3 per cent., £2,008 10s.; renewals, depreciations, etc., £1,400; special reserve, £1,500; balance to next half-year, £731 13s. 11d. The traffic receipts show an increase for the whole year of £3,249 6s. 2d. The whole of the track, overhead lines, and rolling stock, have been kept in repair out of revenue.

Yorkshire (West Riding) Electric Tramways Company.—The tenth annual meeting of this company was held in London on January 22. Sir Herbert S. Leon, the chairman, said that the receipts for the past year were £80 in excess of the previous year. After providing for all expenses, the net income was £26,524, and the divisible balance £32,000. The number of passengers were 10,716,858, and the miles run were 1,778,508. They continue to live on the best of terms with the various local authorities through whose districts they run. Up to now it has not been thought judicious to proceed with the doubling of the track between Normanton, Castleford, and Pontefract, but it will be absolutely indispensable to proceed with that work soon.

Bradford Corporation Tramways show a profit of £23,730 on the past half-year as compared with £20,797 for the corresponding half of last year, an increase of £2,933. The half-year's actual income was £161,817, an increase of £8,559, largely accounted for by the fact that the mileage run shows an advance of 141,000 miles. On the expenditure side there was an increase of £3,300 on maintenance of cars, of £2,815 on wages of drivers and conductors, and £1,695 on electric power. For the two last-named increases the additional mileage run is responsible. Repairs of permanent way account shows a decrease of £3,400, and there is also a decrease of £985 in the amount of rates upon the undertaking. In consequence of extensions and of the equipment of the new railless routes, the interest and sinking fund account shows an increase of £600. The undertaking, apart from the railless system, has suffered a loss for the half-year of £337, but, on the other hand, there is a compensating advantage on the expenditure side. The whole expenditure, including interest and sinking fund, has been only 8d. per mile, or, apart from capital charges, 0·4d. per mile, more than a penny better than in the corresponding half of last year.

Llandudno and Colwyn Bay Electric Railway, Limited.—Mr. A. W. Tait, presiding at the meeting of the company on January 22, said that after providing for operating and administrative expenses, interest on debenture stock, and sinking fund, there was a balance of £4,538 available for distribution. Payment of a dividend at the rate of 4 per cent. per annum would absorb £3,976, leaving £562 to be carried forward. The traffic receipts at £15,671 showed a decrease of £2,038, which was entirely attributed to the interruption of the holiday season by the outbreak of the war. Since the close of the financial year they had had an increase in earnings as compared with the same period last year, due to some extent to the presence of troops both in Llandudno and Colwyn Bay. During the year a length of track of about 1¼ mile was doubled, and there are now two tracks from the centre of Llandudno to the outskirts of Colwyn Bay. Owing to the present financial position the balance of debenture stock has not been placed, but arrangements have been made with the company's bankers for a loan against the security of the debenture stock to complete the Old Colwyn extension. It is not intended to order additional rolling stock at present.

Ten Years of Belfast Tramways.—Speaking at a meeting of Belfast Corporation on January 1, Alderman Tyrrell reviewed the results of the working of the city's tramway system during the last 10 years. He said that the work achieved by the Tramway Committee and the Corporation under the management of Mr. Andrew Nance was a work of first-class importance to the city. Perhaps no other tramway system in the United Kingdom could show a record so satisfactory both financially and beneficially as their own tramway system during the past 10 years. They had set aside out of revenue about £220,000 sinking fund and paid off debt about £45,000, making a total for reduction of debt of about £265,000. They had set aside out of revenue for depreciation or renewal fund about £120,000. They had paid out of revenue to the general purposes fund as a fixed charge £9,000 per annum, making a total of £90,000 in the 10 years. The annual amount of the fixed charges which had to be paid out of the working profit before any available surplus was obtained amounted to nearly £110,000. The falling off in the surplus of the last two years was entirely owing to the increase of debt charges, due to the extensions, and also in the last year to the working expenses of these extensions. The total earned

(Continued on page 110.)

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TRAMWAY AND OMNIBUS SHARE LIST.

Specially Compiled for "The Tramway and Railway World."

Amount Ranking for Dividend.	Shares.	Name.	Div'd. Prev. Half-year.	Div'd. Last Half-year.	Quotations, Feb. 4.	Movement Since July 2. Rise.	Movement Since July 2. Fall.	Latest Business Done. Price.	Latest Business Done. Date.	Yield on Buying Price. £ s. d.	Dividend Due. (Final in Italics.)	Quotations, Jan., 1908, to Feb. 4, 1915. Highest	Quotations, Jan., 1908, to Feb. 4, 1915. Lowest
$6,000,000	$100	Alabama Traction 5% Bonds	5	5	49—51	...	— 18	50½	Jan. 22	...	Mar., Sept.	86	49½
640,000	5	Anglo-Argentine Tramways 5½% Cum. 1st Pref.	2/9	2/9	4⅛—4⅜	...	— ⅛	86 3	Feb. 2	6 5 9	Jan., July.	5 1/16	4 1/16
500,000	5	Do. do. 5½% Cum. 2nd Pref.	2/9	2/9	4—4¼	...	— ¼	81 3	Jan. 19	6 9 6	June, *Dec.*	5 1/16	4 1/16
1,500,000£	...	Do. do. 5% Deb. Stock Red.	5%	5%	87—89	...	— 7/8	87½	Feb. 4	5 13 6	June, Dec.	105½	87
325,532£	Stk.	Auckland Elec. Trys. Co. 5% Mort. Deb. ...	5%	5%	96—99	...	— 5	97½	Jan. 28	5 1 0	Jan., July.	107	97½
75,000	1	Bath Electric Tramways 5% Cum. Pref. ...	6d.	6d.	1/16—1/16	...	...	11/-	July 29	8 17 9	*Jan. & July*	1/8	1/16
334,696£	Stk.	Birmingham Dist. Pow. & Tract. 4½% 1st Deb....	4½%	4½%	82½—84½	...	...	83	Jan. 15	5 6 6	Jan., July.	96	77
15,000	10	Blackpool and Fleetwood Tramways	13/-	4/-	12½ -13½	...	— 1	13⅜	June 29	6 6 0	Feb., Aug.	16	12
60,000	10	Bombay Elec. Supply & Trys Co. 6% Cum. Pref.	6/-	6/-	10½—11	...	— ⅜	10⅜	Jan. 30	5 2 3	Feb., Aug.	12	7⅜
1,003,614	$100	Brazil Traction...	6%	6%	56—60	...	— 19	56¾	Feb. 4	7 14 0	Fb.My.Ag.Nv.	105½	56½
75,000	5	Brisbane Elec. Tramways Investment Co. Ord.	4/-	4/-	6¾—7¼	...	...	7	Feb. 4	5 10 6	*May*, Oct.	9⅛	3 7/16
75,000	5	Do. do. do. 5% Cum. Pref.	2/6	2/6	4¾—5¼	...	...	4⅞	Jan. 29	4 15 3	*May*, Nov.	5⅜	4⅜
50,000	10	Bristol Tramways and Carriage Co.	5	4	5¼—5¾	...	— ¼	5⅛	Jan. 10	8 3 9	*Feb.*, Aug.	14½	5
50,000	10	Do. do. do. 4% Cum. Pref.	4	4	7—7¼	...	— ⅜	6⅜	Feb. 2	5 10 6	Jan., Julv.	9¼	6⅜
800,000£	Stk.	British Columbia Electric Railway Def. Ord. ..	8%	...	88 - 92	...	— 19	106	July 28	...	May, Nov.	156	88
800,000£	Stk	Do. do. Pref. Ord.	6%	6%	89—91	...	— 15	90½	Jan. 26	6 4 3	Feb., Aug.	132¼	89
800,000£	Stk	Do. do. 5% Cum. Perp. Pref.	5%	5%	94—97	...	— 11	102¼	July 24	5 3 3	Jan., July.	114	94
1,070,097£	Stk.	British Electric Traction 6% Prefd. Ord. ..	...	...	10—15	...	— 1½	10	Jan. 8	...	Apr., *Oct.*	19	8
403,503£	Stk.	Do. do. 6% Cum. Pref. ..	6%	6%	75—80	...	— 10	75	Jan. 8	7 10 0	Feb., *Aug.*	95¼	73
1,464,245£	Stk.	Do. do. 5% Perp. Deb. ...	5%	5%	88—91	...	— 3	88	Jan. 4	5 8 9	April, Oct.	101	82½
439,796£	Stk.	Do. do. 4½% 2nd Deb. Red. ...	4½%	4½%	70—75	...	— 4	77½	June 17	5 15 6	May, Nov.	84	58
246,625£	Stk.	Buenos Aires Port & City Trys. 6% 1st Mt. Deb.	6%	6%	68—73	...	— 5	71	Mar. 24	8 4 6	Feb., Aug.	103	61
623,270£	Stk.	Buenos Ayres Lacroze Trys. Stg. 5% 1st Mt. Deb.	5%	5%	99—101	...	— 1	100	July 6	5 0 0	Mar., Sept.	103	89
137,610	5	Calcutta Tramways Ord.	7/-	3/-	6—6½	...	— ½	6¼	Jan. 29	7 14 0	*Apr.*, Oct.	7⅜	4
47,295	5	Do. 5% Cum. Pref.	2/6	2/6	4⅜—4⅝	...	— ⅛	4⅜	Jan. 25	5 0 0	Jan., July	5⅜	4⅜
491,222	1	Cape Electric Tramways	6d.	for yr.	⅞—¾	...	...	14/-	July 18	3 6 9	Feb., *Nov.*	1/2	1/8
15,000	10	Carthagena and Herrerias Steam Tramways ...	1/-	May, '14	2¾—3½	...	...	62/6	Mar. 3	5 14 3	April.	7	2¾
248,000	5	City of Buenos Ayres Tramways (1904) ...	2/6	2/6	4⅞—5⅛	...	— ⅛	4 31/32	Feb. 4	4 17 9	Fe My.Au No	6	4⅛
120,000£	Stk.	Colombo Elec. Trys. & Ltg. 5% 1st Mt. Deb. ...	5%	5%	91—95	...	...	93	July 6	5 6 0	May, Nov.	101	87
11,500	10	Cork Electric Tramways and Lighting Co. ...	...	6/- ann.	4—4½	...	...	4 1/16	Dec. 23	6 13 6	*Mar.*	10	4
12,327	10	Do. do. do. 5% Cum Pref.	5/-	5/-	6½—6¾	...	...	6⅝	July 2	7 8 3	Jan., July	10⅞	6½
3,000	10	Dublin and Lucan Elec. Railway 5% Cum. Pref.	5/-	Nil	6—7	...	...	9	Aug. 25/10	..	Sep.15, Mar.15	9¼	6
60,000	10	Dublin United Tramways Co. (1896), Ltd., Ord.	5/-	5/-	10¼—11¼	+ ⅛	...	11	Feb. 2	4 9 0	Feb., Aug.	14	10 5/16
60,000	10	Do. do. do. 6% Cum. Pref.	6/-	6/-	12—12½	+ ¼	...	12 5/16	Jan. 27	4 18 0	*Feb.*, Aug.	14	11½
268,235	10/-	Hastings and District Elec. Trys Ord.	...	...	1/2—9/16	...	...	1/3	April 17	...	...	5/16	1/16
80,000	1	Do. do. 6% Cum. Pref. ...	6%	6%	1/2—1/16	...	...	10/9	April 17	8 14 6	...	1/8	1/32
125,000£	Stk.	Do. do. 4½% Deb. Stk. Red.	4½	4½	65—70	...	...	65	April 15	6 8 9	April, Oct.	100	65
$9,634,000	$1,000	Havana Elec. Rly. Co. Con. Mort. 5%	5%	5%	87—90	...	— 7½	88½	Jan. 14	5 7 6	Feb., Aug.	105	80
195,000£	100	Hong Kong Tramways Co. 5% Mt. Deb. ...	5%	5%	85½—87½	...	...	82½	July 29	6 5 9	May, Nov.	92	75½
20,000	10	Imperial Tramways Ord.	Nil	4% year	3½—3⅝	+ ⅛	...	3	Mar. 4	11 0 9	Feb., Aug.	9⅜	2½
20,000	10	Do. 6% Cum. Pref.	6%	6%	6¼—6½	...	— ¼	6 7/32	Ju. 28/09	9 4 9	Jan., July.	9½	2¾
30,000	5	Isle of Thanet Elec.Try.& Ltg. Co.5% Cum.Pref.	3/-	Dec. '13	2—2½	...	...	45/-	May 15	...	*Mar.*, Sept.	3	0¾
170,000	1	La Plata Elec. Trys. Co. 6% Cum. Pref. ..	7½d.	...	13/16—15/16	...	...	17/-	Oct. 14	...	*April*, Oct.	1 1/16	0½
30,800	10	Lanarkshire Tramways	6/6	6/-	9⅜—10	...	— ¼	9 1/16	Feb. 4	6 5 0	Feb , Aug.	10 5/16	9⅜
250,000£	Stk.	Lancashire United Trys. 5% Prior Lien Deb....	5%	5%	84½—86½	...	...	87½	June 15	5 15 9	Jan., July.	95	76
634,026	1	Lisbon Electric Tramways Ord.	7¾d.	7¾d.	1⅛—1 1/16	...	...	25/-	June 30	4 11 6	*July.*	1 3/16	⅜
425,553	1	Do. do. 6% Cum. Pref ...	7¾d.	7¾d.	1/16—1⅛	...	...	21/-	June 5	5 8 9	Jan., July.	1½	1/8
1,833,136	1	London and Suburban Traction Ord.	1½d.	...	1/16—3/16	...	...	4/6	Jan. 16	...	...	5/9	3/9
1,581,059	1	Do. do. do. 5% Cum. Pref.	5	5	⅜—⅝	...	...	11/6	July 22	8 0 0	Feb., Aug.	14/-	10 -
1,000,000£	Stk.	London General Omnibus 4½% 1st Deb.	4⅛	4⅛	95—99	...	— 3	97½	Feb. 4	4 11 0	Jan., July.	98¼	92½
1,000,000£	Stk.	Do. do. 5% Cum. Income ...	5	5	87—89	...	— 2	87	Feb. 4	5 15 0	Feb., Aug.	95	85¾
1,649,930£	Stk.	London United Tramways 4% 1st Deb. Stk. ...	4	4	53—57	...	— 1	55	July 25	6 18 0	*Jan.*, July.	82	54½
63,430£	Stk.	Madras Elec. Trys. (1904) Ltd. 5% Deb. Red. ...	5%	5%	99—101	...	...	101½	Oct. 16	4 19 0	Jan., July.	105	86
20,000	5	Do. Do. Do. 6% Cum. Pref. ...	6%	6%	4⅞—5⅜	...	...	5	Jan. 22	5 17 3	Ma., Sept.	5⅜	87/6
300,000£	100	Manaos Trys. & Ltg. Co. 5% 1st Debs.	5%	5%	69—71	...	— 7½	70	Feb. 2	7 1 0	Jan., July.	97	69
$4,785,000	$1,000	Manila Elec. R. R. and Ltg. Corp. 5% Gld. Bds.	5%	5%	95—100	...	— 2	100½	June 10	5 0 9	Mar., Sept.	104⅜	84
60,000	1	Mansfield & District Trys. Ltd 6% Cum. Pref.	7¾d.	7¾d.	1/8—1 1/16	...	...	20/3	Jan. 1	5 13 0	Mar., Sept.	1 1/16	⅜
$20,000,000	$100	Mexico Tramways Common Stock	$1⅜	Nov. '13	40—45	...	30	40	Jan. 15	...	Fb.My.Au.No	151⅛	40
$3,840,000	...	Michigan Untd Rys. Co. 5% 1st Debs & Refdg Bds	5%	5%	90—92	...	...	90½	July 6	5 7 0	May, Nov.	101½	89½
600,000£	100	Montreal Street Rly. 4½% Ster. Debs.	4½%	4½%	99—101	...	...	99½	Jan. 16	4 9 6	Fe.My.Au.No.	107	97
150,000	1	National Steam Car	5%	year	⅜—⅝	...	— 1/16	12/3	Jan. 30	8 0 0	Dec.	39/9	8/9
50,000	1	Oldham, Ashton, and Hyde Elec. Tramways Ord.	6 year	Nil	12/- —13/-	...	— 1/-	14/-	Apr 2/13	...	Mar., Aug.	18/9	11/6
50,000	1	Do. do. do. 5% Cum. Pref.	5%	5%	⅝—¾	...	...	14/6	Jan. 9	6 13 6	Feb., Aug.	17/-	12 4½
77,893	5	Para Elec. Rly. and Ltg. Co., Ord.	5/-	..	4—4½	...	...	4 1/16	June 10	11 2 3	May, Nov.	8	4
245,000	1	Potteries Electric Traction Ord.	3½	for '13	1/2—13/16	...	...	7/6	May 6	8 12 6	April.	⅜	⅛
245,000	1	Do. do. 5% Cum. Pref. ...	6d.	6d.	11/16—13/16	...	— 1	10/7½	Feb. 2	7 12 6	*Feb.*, Aug.	⅜	1/16
124,560	1	Provincial Tramways Ord.	8d.	10d.	1/2—1/8	...	...	16 6	Feb. 3	8 0 0	May. *Nov.*	1 1/16	13/-
10,000	10	Do. do. 6% Cum. Pref.	6/-	6/-	10—10½	...	— ⅜	9¾	July 17	5 17 3	June, *Dec.*	11	9
50,000	5	Rangoon Elec. Trys. & Supply Co. 6% Cum. Pref.	3/-	3/-	4⅞—5⅛	...	...	5 1/32	July 11	5 11 9	June, Dec.	6	4⅝
32,000	10	Shanghai Elec. Construction Co.	14/-	year	12½—13½	...	...	12¾	June 27	5 3 9	May.	13 1/16	6
330,400£	Stk.	Singapore Elec. Trys. Ltd., 5% Debs. Red. ...	5%	5%	88—92	...	...	89	April 2	5 8 9	Mar., Sept.	92	61
91,720£	Stk.	Southern Elec. Trys. of B.A., 1st Mt. Deb. ...	5%	5%	98—101	+ 4	...	99½	Jan. 22	5 1 0	Feb., Aug.	102	90
471,500£	100	Toronto Rly. Co. 1st Mt. 4½% Stg. Bonds ...	4½%	4½%	94½—95½	...	...	94½	Jan. 15	4 16 3	Feb., Aug.	104	94½
80,000	5	United Elec. Tramways of Monte Video, Ord ...	4/-	2/-	4¾—4⅞	...	...	98/9	May 19	6 9 9	*June*, Dec.	6⅜	4¼
90,000	5	Do. do. do. 6% Cum. Pref.	3/-	3/-	4⅞—5⅛	...	...	4 1/16	June 19	5 14 3	June, Dec.	6⅜	4 5/16
500,000£	Stk.	Winnipeg Elec. Rly. Co. 4½% Perp. Cons. Debs.	4½%	4½%	90—93	...	— 3	91½	Feb. 4	4 14 3	Apr., Oct.	109⅜	90
40,977	5	Yorkshire (West Riding) Elec. Trys. Ord. ...	...	...	¼—⅜	...	...	6/6	Jan. 26	...	*Mar.*	1⅜	⅜
46,261	5	Do. do. do. 6% Cum. Pref.	2/6	3/-	4—4¼	...	...	91/3	July 23	6 2 3	*Mar.*	4⅜	1⅜

ELECTRIC RAILWAY STOCKS.

1,854,720£	Stk.	Central London Ord. Stock (4% Guar.)	...	4	76—78	...	— 6	76½	Feb. 3	5 2 9	*Feb.*, Aug.	89⅛	59⅝
572,640£	Stk.	Do 4% Guar. Pref. Stock	4	4	80—82	...	— 4	81	Jan. 30	5 0 0	Feb., Aug.	92	80
572,640£	Stk.	Do. Deferred Stock (4% Guar)	4	4	76—78	...	— 4	77	Jan. 19	5 2 9	Feb., Aug.	91⅜	42
50,000	10	Liverpool Overhead Ord.	3/6	2/6	4¼—4½	...	— ¼	4 3/16	Feb. 2	6 13 6	*Feb.*, Aug.	4¼	⅜
1,412,263£	Stk.	Mersey Cons. Ord. Stock	Nil	Nil	4½—5	...	— 1	6	June 11	...	*Feb.*, Aug.	8	1
5,732,062£	Stk.	Metropolitan Cons.	1⅜	1⅜	30¼—31½	...	— 9	31 1/16	Feb. 4	5 3 3	*Feb.*, Aug.	75⅛	30½
2,640,914£	Stk.	Do. Surplus Lands Stock	2¾	2¾	57—59	...	— 2	57½	Feb. 3	4 13 3	*Feb.*, Aug.	72	57
3,235,000£	Stk.	Metropolitan District Ord.	Nil	Nil	17⅛—18½	...	— 6½	18	Feb. 2	...	*Feb.*, Aug.	51⅛	9⅛
500,000	10	Underground Electric Railways Co. of London ...	...	...	1⅜—2	...	— 1⅜	38/9	Feb. 4	...	...	5 3/16	1⅜
1,730,000£	...	Do. 4⅛% Bonds of 1933	4⅛%	4⅛%	97—100	...	...	98¾	Feb. 4	4 10 0	Jan., July	102	73
1,192,707£	...	Do. 6% 1st Income Debs.	6%	6%	112—115	...	— 2	114⅜	Feb. 4	5 4 6	Mar., Sept.	118	108
6,120,750£	Stk.	Do. 6% Income Bonds	60/-	60/-	82—84	...	— 7	82½	Feb. 4	7 3 0	Mar., Sept.	97⅛	18
1,150,477	1/-	Do. "A" Ord.	...	...	1/16—3/16	...	— 1/16	6/1⅛	Feb. 3	...	...	17/6	¼

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in surpluses was £68,061. If to that were added the £90,000 handed over from the revenue as a fixed charge it made an aggregate surplus for the 10 years of nearly £160,000. He also pointed out improvements that had been effected in the service, in the track, the speed of the cars, the lengthening of the stages, the earlier start in the mornings, the reduction from threepence to twopence for "all the way," increase of wages of motormen and conductors, and reduction of their hours. No other city or large town ran so many workmen's cars per 1,000 of the population. The annual receipts had increased from £125,000 to £275,000; the annual working profit had increased from £32,000 to £112,000. The annual number of passengers had increased from 28 to 63 millions. The general manager estimated that the saving to the public by reduced fares had resulted in an aggregate gain to its members of nearly £350,000 in the 10 years. No other British tramway could show anything like so good a record, either financially or beneficially, as this for the first 10 years of working.

DIVIDENDS OF THE "UNDERGROUND" GROUP.

Underground Electric Railways of London.—The revenue of the company will enable it to pay full interest to December 31, 1914, on its 6 per cent. first cumulative income debenture stock and on its 6 per cent. income bonds, and to carry forward about £35,000. A year ago similar interest was paid, £45,000 being carried forward.

London General Omnibus.—Dividend on the ordinary shares for the six months ended December 31 last of 8 per cent., making a distribution for the year 1914 of 16 per cent., with £175,000 placed to reserve, and £64,547 carried forward. For 1913 the dividend was 18 per cent., £175,000 being placed to reserve, and £34,197 carried forward.

London Electric Railway.—Dividend on the ordinary shares for the past six months will be at the rate of ¼ per cent. per annum, making with the interim dividend of 1 per cent. per annum a dividend for the year of ⅝ per cent. The sum carried forward is £11,547. For the preceding year the distribution was 1 per cent. and the carry forward £1,086.

Metropolitan District Railway.—The directors recommend dividends in full on the 4 per cent. guaranteed stock and on the 4½ per cent. preference stock. The dividend on the 5 per cent. second preference stock for the past six months will be at the rate of £1 per cent. per annum, making with the 3 per cent. interim dividend a dividend for the year of £2 per cent. The carry forward is £13,937. Twelve months ago the 5 per cent. second preference stock received £2 10s. per cent. for the year, the carry forward being £12,659.

City and South London Railway.—Dividend on the 5 per cent. preference stocks, 1891 and 1896, for the six months ended December 31, 1914, at the rate of 5 per cent. per annum, making a dividend for the year 1914 of 5 per cent. No dividend will be paid on the 5 per cent. preference stocks, 1901 and 1903, for the half-year ended December 31, 1914. For the first half of 1914 the preference stocks, 1901 and 1903, received a dividend at the rate of 5 per cent. per annum. For 1913 the preference stocks, 1891, 1896, 1901, and 1903, received a dividend of 5 per cent.

Central London Railway.—Dividends on the undivided ordinary stock for the six months ended December 31, 1914, at the rate of 2¼ per cent. per annum, making a dividend for the year 1914 of 2⅝ per cent. On the preferred ordinary stock for the six months at the rate of £4 per cent. per annum, making a dividend for the year 1914 of £4 per cent.; and on the deferred ordinary stock for the year ended December 31, 1914, a dividend of 1¼ per cent., carrying forward £15,413. For 1913 the dividend on the undivided ordinary stock was 3 per cent., and on the deferred ordinary 2 per cent., £20,878 being carried forward.

DUBLIN TRAMWAYS COMPANY MEETING.

The annual meeting of the Dublin United Tramways Company was held on February 2, Mr. W. M. Murphy, chairman of the company, presiding. The secretary, Mr. R. S. Tresilian, having read the notice, the chairman, in moving the adoption of the report and statement of accounts, lucidly explained the various accounts in a speech of considerable length, calling attention, at the outset, to the fact that he had to deal for the second time with the accounts for a whole year instead of for a half-year as formerly, the first occasion being the year 1913, which included a period of strikes and unrest in Dublin unexampled, and still fresh in the public memory. Dealing with the revenue account, Mr. Murphy pointed out that, though the strike was practically broken at the end of 1913, attacks on the company's cars were continued in the first months of 1914, and more than half that year had passed before the revenue-earning position was fully recovered. Compared with 1912, which was a good year, the receipts were down £430 at the end of June last, but by the end of 1914 the gross receipts were £3,066 above those of 1912, and £24,166 above those of 1913. The war, by causing the abandonment of Dublin Horse Show, and otherwise affecting the commerce of the community, had reduced their receipts below what they otherwise would have been; but on the whole the company had no reason to complain, and might look forward to the future with confidence. The directors' report, of which we append a summary, stated that the amount available for division is £98,047 5s. 7d. *Ad interim* dividends amounting to £32,343 15s. were paid on August 8, 1914, leaving £65,703 10s. 7d. now available. Out of this sum it is recommended that a dividend at the rate of 6 per cent. per annum, less income tax, be paid on the preference shares for the half-year ended December 31, 1914, and that a final dividend at the rate of 5 per cent. per annum, less income tax, be paid on the ordinary shares for the half-year ended December 31, 1914, and that £18,000 be set aside towards renewal of permanent way, and £5,000 to reserve and renewals fund. The dividends and sums set aside will absorb £54,337 10s., leaving £11,336 0s. 7d. to be carried to next account. The report was adopted.

EDINBURGH TRAMWAY COMPANY.

The Edinburgh and District Tramway Company held their annual meeting on Tuesday, February 2, in the North British Station Hotel. Mr. Hall Blyth, who presided, in moving the report, which has already been published, referred to the intention of Edinburgh Corporation to take over the tramways at the end of the company's lease, June 13, 1919, and forecasted some of the conditions which, in the interests of sound finance, must be observed in the transfer, the taking over of the cable cars of the company being one of the most essential. He also intimated that the directors intended to oppose strenuously the bill of the Caledonian Railway Company, by which they sought powers to run motor 'buses from any of their stations to any point they chose to select. Mr. Hall Blyth, at the close of the proceedings, moved a vote of thanks to the officials of the company, specially acknowledging the services of Mr. Shepherd, the general manager; Mr. Harris, the engineer; and Mr. Aitken, the accountant. There was, he said, no harder-working man in Edinburgh than their general manager, and there was no man who understood tramway traffic better, or who considered the comfort of the public more than Mr. Shepherd. Responding to a similar compliment paid him at the luncheon held after the meeting, Mr. Shepherd assured the directors and shareholders that he never wished to be at the head of a better staff than that which served the Edinburgh and District Tramway Company.

The report stated that the sum at the credit of the preferred shareholders is £5,673, which the directors recommended should be dealt with as follows: In payment of ordinary dividend for the half-year to December 31 at the rate of 5½ per cent. per annum, £2,062; in payment of additional dividend of 4 per cent. for the year to December 31, £3,000; and in carrying forward to the credit of the preferred shareholders, £611. The sum at the credit of the deferred shareholders is £8,679, and the directors recommend that this sum should be dealt with as follows: In payment of a dividend of 8s. per share (on £1 shares) for the year to December 31, £7,000, and in carrying forward to the credit of the deferred shareholders, £1,679. Last year the dividend was at the rate of 4s. per share. The gross receipts for the past year amounted to £312,990, an increase of £17,888; and the total expenditure was £276,672, an increase of £8,147. Receipts per car-mile averaged 11·27d., working expenses 5·88d., Corporation charges for rent 4·08d., and the total expenditure 9·96d. There was thus a profit of 1·31d. per car-mile run. The mileage open is 25·75 miles, and the car-mileage reached 6,663,981, an increase of 186,520, while the passengers carried totalled 67,602,916, an increase of 3,980,540.

DEATH ALLEGED DUE TO ELECTRIC SHOCK.

At Wolverhampton County Court, on January 24, Harriet Simcox applied for arbitration under the Workmen's Compensation Act, on behalf of herself and her three children, the sole dependents of her husband, Thomas Henry Simcox, who, it was alleged, was killed by an accident on the Wolverhampton tramways, during his employment as a motorman by the Corporation, on November 18, 1914. It was stated in evidence that on that date Simcox was driving a tramcar from Wolverhampton in the direction of Willenhall when it left the rails. Shortly afterwards a car from Willenhall came up, and by means of a cable power was transmitted to the derailed car. One attempt was unsuccessful, but at the second the lights on the derailed car came on. Simcox was seen to collapse, and the current was disconnected, but the man was found to be dead. The medical evidence showed that Simcox suffered from heart disease, and Mr. Henry Lea, consulting engineer, Birmingham, said that if the insulation of the car had been defective there might have been electric shock, but that he had tested the insulation of the car and found it perfect. In giving judgment, Judge Howard Smith said it was really a hopeless case for the applicant. He was advised by the medical assessor, and he agreed with him, that Simcox died as a result of the condition of the heart. Electric shock might have determined the cause, but Dr. Brown agreed with him that there was no evidence to show that there had been electric shock at all. The verdict would be for the respondents, with costs. The Corporation, it was stated, had made an offer to the widow, which, in the opinion of the defending counsel, was handsome.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	*May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186.885	246,163	169,987	84,276	991	85.267
Accrington	*Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne	*Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1914	Sept., 1901	,,	9 30	...	...	...	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham	*Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn	*Mar. 25, 1914	Mar., 1899	,,	24 63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool	*Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	*Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford	*Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	*Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	*Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	*Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1914	June, 1903	,,	21 2 (b)13 21	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l)29,518	69,745	335	70,080
Chester	*Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield	*Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester	*Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	*Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington	*Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	*Mar. 31, 1914	July, 1904	E.	22 20	...	...	...	245,332	11,026	177,676	67,656	(l)32,356	E51,126	1,048	52,174
			H.		...	...	...	...	...	...	...	...	H 429	19	448
Doncaster	*Mar 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham	*Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	*Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester	*Mar 31, 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	*Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	*Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	*Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	*Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,745	32,468	16,961	942	8,845	313	9,158
Kilmarnock	*May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy	*May 15, 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster	*Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	*May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	*Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool	Dec. 31, 1913	Nov., 1898	E.	119 0	...	...	...	2,024,706	17,014	1,177,384	1,091,771	428,318	677,881	13,018	690,899
Lowestoft	*Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone	*Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester	*Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	*Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	*Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham	*Mar. 31, 1914	Jan., 1901	,,	...	...	...	...	667,705	...	410,091	237,501	68,372	172,731	2,648	175,379
Oldham	*Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth	*Mar. 31, 1914	Sept., 1899	,,	15 0	...	...	...	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall	*Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,875	369	27,242
Rochdale	*Mar. 31, 1914	May, 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham	*Mar. 31, 1914	Jan., 1903	,,	12 2	...	183,775	...	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	*Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton	*Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport	*Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields	*Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l)26,881	37,744	586	38,330
Staly'ge, H., M., D.	*Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport	*Mar. 31, 1914	Aug., 1901	,,	27 5	...	...	...	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland	*Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey	*Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1913	Dec., 1902	,,	19 44	188,145	188,100	45	183,351	9,378	159,561	58,366	33,873	32,991	682	33,673
Walthamstow	*Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington	*Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham	*Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	*Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	*Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)	*Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	*Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1914	Nov., 1905	E.	98 54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	*Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	*Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth	*Mar. 31, 1914	July, 1902	,,	(e) 29 62	432,440	...	...	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	*Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry	*Mar. 31, 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1914	Oct., 1898	,,	193 40 (b) 2 53	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
Huddersfield	*Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	*Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	*Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester	Dec. 31, 1913	May, 1904	,,	37 0	929,120	727,405	201,715	739,982	19,999	602,478	129,807	100,000	147,458	17,059	164,517
London	*Mar. 31, 1914	...	H.	13 73									21,145	480	21,635
		May, 1903	C.E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	*Mar. 31, 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton	*Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth	*Mar. 31, 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	*Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	*Mar. 25, 1914	Sep., 1899	,,	79 3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	*Mar. 31, 1914	...	,,	31 55	496.423	496.423	...	628.151	19.821	496.423	46.836	120.191	157,096	1,161	158.257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Additional lines leased and worked. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1½ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit.	Deductions from Gross Profit.					Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal.	Sundries.	Total.	
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,810	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,033	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	50,721	9,423	16,898	20,151	77,193	66,581	995	(h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	35,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,432	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 306
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	180,226	61,361	84,026	121,185	446,798	244,101	24,220	48,971	60,318	...	(d) 54,163	e) 4,869	168,321	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1, 310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	...	...	...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,294	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,019	3,201	4,678	5,710	21,608	12,065	1,371	5,191	3,439	458	1,868	...	10,956	+ 2,480
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,008
Leicester	54,257	10,405	21,566	23,887	110,115	54,402	3,763	23,541	12,453	2,122	7,636	2,413	48,165	+ 10,000
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	(m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,536
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 18,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses.
(n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account.
(r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit on motor char-a-banc. (z) Includes £6,519 rent of leased lines. ; £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	*d.*	*d.*	*d.*	*d.*	*d.*	*d.*	%	*d.*		*d.*	
Aberdeen ...	...	12,989	...	11·17	**11·04**	2·916	1·348	·940	·956	**6·16**	**55·16**	5·415	2,170,033	·80	**1·184**
Accrington ...	...	...	1,568	12·64	**12·49**	3·17	1·18	·94	2·04	**7·33**	**57·99**	5·29	949,054	**1·23**	**1·65**
Ashton-u-Lyne	47	...	3,050	12·4197	**12·0692**	2·6622	·8695	1·5788	1·7434	**6·8539**	**55·19**	5·1105	640,413	**1·25**	**1·38**
Ayr...	...	1,141	...	10·45	**9·88**	2·26	1·12	1·02	1·32	**5·75**	**55**	4·42	421,844	**1·39**	**·94**
Birmingham ...	...	31,000	44,972	10·689	**10·564**	3·080	1·009	1·492	1·913	**7·494**	**70**	5·581	24,257,823	**1·125**	**1·70**
Blackburn ...	4,011	...	...	14·08	**13·46**	3·41	·97	2·93	2·06	**9·37**	**66·10**	7·37	1,901,668	**1·3**	**1·64**
Blackpool ...	...	2,553	12,000	18·91	**18·74**	3·71	1·52	2·17	2·29	**9·69**	**51·28**	7·40	1,506,323	**1·63**	**1·40**
Bolton	417	...	17,500	11·944	**11·838**	2·552	·782	1·404	1·674	**6·412**	**53·064**	4·664	4,396,543	**1·1**	**1·52**
Bradford	...	...	17,200	12·166	**11·486**	3·204	1·051	2·173	1·948	**8·376**	**73·138**	6·428	12,041,279	**1**	**1·924**
Brighton	842	...	...	11·794	**11·33**	3·049	·978	2·992	1·787	**8·806**	**74·66**	7·02	1,722,548	**1·2**	**1·49**
Burnley	...	...	7,687	12·079	**12·043**	3·185	1·035	1·640	2·749	**8·609**	**71·37**	5·86	3,894,011	**1·24**	**2·22**
Burton-on-Trent	1,163	...	...	9·02	**8·28**	2·97	·82	1·40	1·72	**6·91**	**76·7**	5·08	545,672	**1·39**	**1·08**
Bury	...	(*k*)1,000	5,000	10·38	**10·26**	2·315	·769	1·213	1·252	**5·549**	**50·44**	4·297	2,037,620	**1**	**1·252**
Chester	...	1,531	...	9·17	**8·84**	2·27	1·06	·83	1·45	**5·61**	**61**	4·17	378,158	**1·33**	**1·08**
Chesterfield ...	...	457	...	11·1	**10·8**	2·54	1·08	2·31	1·73	**7·66**	**68·9**	5·93	420,824	**1·25**	**1·38**
Colchester ...	...	...	...	8·058	**7·682**	2·058	·95	1·61	1·897	**6·515**	**80·36**	4·618	410,555	**1·5**	**1·26**
Croydon	...	230	...	7·464	**7·284**	2·568	·599	1·254	1·561	**5·982**	**79·53**	4·42	2,874,462	**1·522**	**1·027**
Darlington ...	...	...	...	8·230	**8·068**	2·676	·505	1·241	1·251	**5·673**	**68·93**	4·422	482,791	**1**	**1·25**
Darwen	445	...	...	14·96	**14·09**	3·20	·92	2·96	2·31	**9·39**	**65·25**	7·08	469,939	**1·312**	**1·77**
Derby	(*n*) 75	...	...	E 10·358 H. 6·077	**10·150** **5·821**	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	**6·816** **8·424**	**65·8** **138·6**	5·107 ...	1,425,112 ...	**1·45** ...	**1·179** ...
Doncaster ...	...	654	...	10·52	**10·37**	2·24	·61	2·97	1·90	**7·72**	**73·1**	5·82	799,965	**1·25**	**1·51**
Dundee	...	12	1,000	12·018	**11·716**	3·026	1·031	1·639	1·815	**7·511**	**62·49**	5·696	2,520,470	**1**	**1·815**
East Ham ...	..	...	...	8·73	**8·59**	2·98	1·08	1·92	1·67	**7·65**	**87·60**	5·98	2,385,535	**1·062**	**1·58**
Exeter	...	1,724	...	9·456	**9·404**	2·628	·738	·797	2·059	**6·222**	**65·8**	4·163	565,247	**1·625**	**1·27**
Gloucester ...	...	...	...	6·77	**6·32**	2·64	·64	1·21	·72	**5·21**	**77**	4·49	481,967	**1**	**·72**
Halifax	1,818	5,792	6,033	11·738	**11·627**	3·130	·836	1·692	2·186	**7·844**	**67**	5·66	4,357,466	**1·125**	**1·94**
Ilford	...	...	...	6·891	**6·768**	2·862	·688	1·048	1·278	**5·877**	**80·9**	4·598	1,079,384	**1·065**	**1·175**
Ilkeston	...	...	...	7·04	**6·87**	2·3	·8	1·3	1·4	**5·8**	**83**	4·4	372,200	**1**	**1·54**
Ipswich	...	...	...	8·552	**8·242**	3·065	·807	2·002	1·265	**7·139**	**83·47**	5·874	676,189	**1·25**	**1·011**
Keighley	...	...	...	9·064	**8·754**	2·664	·761	·890	1·595	**5·910**	**65**	4·315	254,636	**1·5**	**1·05**
Kilmarnock ...	...	...	...	7·539	**7·326**	2·57	·61	1·07	1·38	**5·63**	**74·6**	4·246	329,577	**1·25**	**1·14**
Kirkcaldy ...	341	...	500	9·162	**8·936**	2·522	·727	1·024	1·573	**5·846**	**65·43**	4·273	739,564	**1**	**1·573**
Lancaster ...	...	...	...	8·23	**7·94**	3·14	·71	1·16	2·19	**7·20**	**88**	5·02	225,094	**1·7**	**1·29**
Leith	...	...	...	9·54	**9·24**	2·46	·79	1·29	·99	**5·53**	**57·98**	4·54	939,737	**1·001**	**·99**
Leyton	...	...	...	9·355	**9·151**	(*c*) 2·959	1·140	1·815	1·710	**7·624**	**81·338**	5·914	3,043,900	**1·019**	**1·678**
Lincoln	853	...	...	10·36	**10·17**	2·15	·94	1·42	1·40	**5·91**	**57**	4·51	190,838	**1·25**	**1·12**
Liverpool ...	...	...	100,000	12·34	**12·10**	3·217	1·096	1·500	2·164	**7·977**	**63·2**	5·813	23,928,396	**1·138**	**1·78**
Lowestoft ...	...	...	...	9·1	**8·8**	2·60	·5	1·2	1·8	**6·1**	**67·64**	4·3	318,601	**1·75**	**1·03**
Maidstone ...	...	...	...	8·51	**8·06**	2·02	·81	1·34	1·48	**5·65**	**70·07**	4·17	371,290	**1·25**	**1·2**
Manchester ...	...	...	103,090	11·410	**11·236**	3·411	1·103	1·105	1·597	**7·216**	**63·25**	5·619	30,035,057	**1·034**	**1·543**
Nelson	1,980	...	...	12·85	**12·78**	3·00	·81	1·81	2·51	**8·13**	**63**	5·62	255,621	**2**	**1·26**
Newport (Mon.)...	...	...	...	10·207	**9·950**	2·605	1·056	3·239	1·653	**8·553**	**83·74**	6·913	1,187,262	**1·29**	**1·23**
Nottingham ...	...	7,013	24,000	...	**11·87**	3·04	1·04	1·34	1·92	**7·34**	**61·82**	5·42	5,359,804	**1·25**	**1·51**
Oldham	...	4,901	...	13·422	**13·228**	3·109	·992	2·570	2·376	**9·047**	**67·40**	6·671	3,291,607	**1·5**	**1·585**
Perth	...	...	...	8·79	**8·31**	3·02	·66	·39	1·19	**5·26**	**59**	4·07	277,474	**1·08**	**1·09**
Plymouth ...	...	...	4,037	12·066	**11·450**	2·42	1·11	1·29	2·298	**7·12**	**60·83**	4·82	1,159,069	**1·66**	**1·38**
Pontypridd ...	355	...	...	12·16	**11·99**	2·78	·78	3·04	1·78	**8·38**	**68·89**	6·6	613,719	**1·25**	**1·42**
Rawtenstall ...	...	621	...	10·81	**10·66**	2·33	1·18	1·24	1·71	**6·46**	**59·61**	4·75	813,483	**1·28**	**1·34**
Rochdale	8,490	...	...	11·163	**11·123**	2·520	·692	1·307	1·556	**6·075**	**53·4**	4·519	2,610,994	**1·006**	**1·546**
Rotherham ...	E. ... R.T....	4,287 1,009	750 ...	12·54 10·74	**13·52** **10·74**	2·92 2·44	·87 ·76	2·22 2·68	2·79 1·23	**8·80** **7·11**	**70·15** **66·20**	6·01 5·88	1,731,184 120,303	**1·375** **1·375**	**2·03** **1·07**
Salford	...	...	22,000	10·501	**10·499**	3·059	·916	·970	1·936	**6·881**	**65**	4·945	9,812,392	**1·23**	**1·606**
Southampton ...	6,577	...	2,360	10·974	**10·520**	3·105	·779	1·432	1·915	**7·231**	**66**	5·316	2,004,408	**1·5**	**1·29**
Southend-on-Sea	2,514	1,000	6,000	13·14	**12·97**	3·03	·85	1·33	2·33	**7·54**	**57·35**	5·21	848,538	**1·75**	**1·33**
Southport ...	...	...	...	9·763	**9·528**	2·462	1·101	1·607	1·554	**6·725**	**68·8**	5·171	468,554	**1·5**	**1·011**
South Shields ...	(*d*) 500	4,907	1,700	10·244	**10·087**	2·362	·993	·971	1·710	**6·036**	**58·92**	4·326	1,105,203	**1·388**	**1·231**
Stalybridge, &c.	...	...	...	8·426	**8·365**	2·711	1·013	1·278	1·394	**6·396**	**75·92**	5·002	1,793,157	**·9**	**1·549**
Stockport ..	...	250	12,250	10·958	**10·745**	2·388	·738	1·618	·961	**5·705**	**47·94**	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	**11·943**	3·128	·844	1·034	1·799	**6·805**	**56·97**	5·0	1,804,219	**1·5**	**1·19**
Wallasey ...	1,443	3,000	7,750	11·844	**11·739**	3·287	·891	1·211	2·138	**7·527**	**63·5**	5·38	1,971,378	**1·4**	**1·52**
Walsall	1,480	...	1,000	11·234	**11·007**	2·675	1·068	1·561	1·905	**7·209**	**64**	5·304	845,654	**1·68**	**1·176**
Walthamstow ...	...	...	...	8·09	**7·94**	3·05	·66	1·53	1·76	**7·00**	**86·6**	5·24	1,495,460	**1·375**	**1·28**
Warrington ...	739	...	2,500	12·521	**12·246**	3·161	·966	2·096	1·798	**8·021**	**68·273**	6·223	545,817	**1·5**	**1·199**
West Ham ...	...	...	...	9·27	**9·075**	3·417	1·154	2·137	1·353	**8·061**	**88**	6·708	6,974,894	**·75**	**1·85**
Wigan	4,690	...	...	12·77	**12·46**	2·655	·836	1·862	1·761	**7·11**	**56·07**	5·35	2,216,740	**1 3/16**	**1·476**
Wolverhampton	...	...	5,553	11·485	**11·333**	2·569	1·039	1·530	1·513	**6·651**	**57·9**	5·138	1,845,821	**1**	**1·542**
Yarmouth (Gt.)...	...	...	...	8·738	**8·563**	2·583	·616	1·016	1·649	**5·864**	**68·48**	4·215	758,296	**1·56**	**1·052**
York	...	2,524	...	9·08	**8·86**	2·95	·69	·66	1·78	**6·08**	**67**	4·30	1,009,827	**1·25**	**1·43**

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	**9·38**	2·72	·44	1·46	·99	**5·61**	**58·91**	4·62	11,000,708	**·617**	**1·37**
Bexley	...	..	...	11·13	**12·3**	2·53	·85	2·82	·68	**6·88**	**71·1**	6·20	487,110	**·827**	**1·66**
Birkenhead ...	...	...	...	12·643	**12·496**	3·140	·991	2·170	1·336	**7·637**	**60·33**	6·30	2,672,599	**·65**	**2·054**
Bournemouth ...	...	2,000	...	12·83	**12·76**	2·95	1·02	1·26	(*b*) 1·99	**7·22**	**56·21**	5·23	3,245,277	**·67**	**1·65**
Cardiff	845	2,047	9,600	11·65	**11·45**	3·563	·900	1·468	·850	**6·781**	**60**	5·931	5,073,942	**·488**	**1·71**
Coventry ...	419	...	...	9·271	**9·115**	2·742	·953	1·694	·819	**6·208**	**66·9**	5·389	1,652,029	**·544**	**1·47**
Glasgow	...	...	53,892	10·659	**10·609**	3·271	1·318	1·536	·526	**6·651**	**62·69**	6·125	33,685,570	**·378**	**1·38**
Huddersfield ...	6,662	14,634	...	11·34	**10·98**	2·78	·61	2·72	·81	**6·92**	**61·01**	6·00	4,881,338	**·42**	**1·94**
Hull	...	7,270	7,000	9·47	**9·41**	2·85	·85	2·38	·67	**6·75**	**71**	6·02	5,710,219	**·50**	**1·35**
Leeds	...	...	70,005	11·145	**11·042**	2·967	1·073	1·070	·792	**5·902**	**52·96**	5·110	17,175,710	**·493**	**1·801**
Leicester	...	...	10,000	9·801	**8·785**	3·232	·620	1·285	1·423	**6·560**	**66**	5·137	7,141,333	**·411**	**1·77**
London	...	...	...	E. 9·21 H. 8·15	**8·94** **7·97**	3·32 4·07	·76 1·39	1·41 1·53	1·01 4·40	**6·50** **11·39**	**70·55** **139·72**	5·49 11·39	154,048,461 ...	**·601** ...	**2·63** ...
N'castle-on-Tyne	...	25,135	13,470	11·709	**11·253**	3·222	1·144	1·217	1·031	**6·614**	**54·96**	5·583	10,231,454	**·421**	**1·922**
Northampton ...	...	1,200	500	10·69	**10·39**	2·87	1·15	1·03	1·80	**6·85**	**64**	5·05	966,282	**1·23**	**1·47**
Portsmouth ...	10,702	(*i*) 3,000	5,000	11·204	**11·030**	3·033	1·057	·852	·576	**5·518**	**49·25**	4·942	3,056,720	**·521**	**1·103**
Preston	...	5,041	1,300	10·75	**10·54**	2·890	1·168	2·164	·700	**6·922**	**64·40**	6·222	1,765,250	**·407**	**1·49**
Reading	...	2,529	1,890	9·261	**8·996**	2·201	·933	1·042	·917	**5·093**	**55**	4·18	1,170,173	**·737**	**1·12**
Sheffield	7,032	2,000	30,581	10·527	**10·431**	3·286	·755	1·298	·949	**6·288**	**59·732**	5·339	18,601,705	**446**	**1·933**
Wellington, N.Z.	15,431	...	...	16·309	**16·189**	5·974	·801	2·259	1·850	**10·884**	**65·86**	9·034	4,769,149	**·906**	**2·05**

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (*b*) Including current supplied by Bournemouth and Poole Supply Company. (*c*) Horse account ·054d. (*d*) Accident, insurance, and compensation fund. (*f*) Insurance fund. (*i*) Including Insurance. (*k*) Insurance. (*n*) Remainder expended in paying capital expenditure not borrowed. (*t*) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		d.	Miles.	d.	Miles.			
Aberdeen ...	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10·3	·508	1·80	·58	7·5	703	54	77
Accrington...	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13·1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11·1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,244	146,930,986	10·29	1·03	169	79·77	5,482	14·5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,149,482	12,731,532	11·07	1·28	63·15	105	2,751	6·10	·88	1·25	·76	7·5	448	32	61
Blackpool ...	67,500	1,075,943	14,283,802	13	1·41	211·7	86·7	4,524	24·9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13·	·578	1·553	·633	7·25	1,030	73	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16·2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10·1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6·3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10·10	·543	1·24	·85	8·51	483·83	45·26	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6·7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5·5	·78	1·38	·75	7·33	126	7	17
Colchester ...	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4·8	1·20	·88	·96	6·78	142·27	9·88	18
Croydon ...	178,094	2,801,302	19,227,878	6·87	1·06	107·6	129	4,818	9·10	·871	2·05	·50	8·14	942·23	59	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·48	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	..	...	...	...	...	...
Derby ...	124,000	E 1,208,880	12,136,148	10·033	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935			...	...	1·35	1	1	..	...	..	3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7·7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8·2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7·2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6·3	·75	1·5	·65	7·08	264·1	19	30
Halifax ...	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12·4	·867	1·30	·87	7·23	853·93	77	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,256	5·7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52·8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4·1	·462	2·22	·45	6·87	126	7	12
Kilmarnock ...	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8·10	·475	1·522	·64	7	185	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2·9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6·8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6·11	·532	1·75	·428	7	90	5	8
Liverpool ...	839,000	13,442,605	144,085,927	10·72	1·129	172	77	5,695	16/2	·744	2·514	·39	7·5	4,920	480	595
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8·4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19·3	·683	...	...	...	...	..	662
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/–	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,543,669	40,535,874	11·43	1·02	155	92·72	...	13·2	·642	1·70	1	6·66	...	105	135
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,156	12/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	..	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd...	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10·9	·751	1·12	·88	9	247·5	15	24
Rochdale ...	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham...	64,000	E 852,639	9,874,231	11·58	1·08	154·3	...	3,701	13,9	·76	...	...	...	...	...	...
	...	RT 128,685	471,690	3·67	2·72	...	...	...	...	1·92	...	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15·7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543,941	13,162,224	8·52	1·23	108	77·38	3,624	11·1	·82	1·25	·55	...	...	...	70
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	...	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	719,372	6,121,381	8·509	1·293	61	86	1,885	6·7	·847	1·24	·79	7	345	23	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	450	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham ...	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9·7	·73	1·80	·51	7·75	1,235	95	118
Wigan ...	200,000	1,500,846	14,235,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8·4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6·2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,703	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley ...	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9·11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17·5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,417	15·6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow ..	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14·1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds ...	525,000	9,204,331	93,673,774	10·17	1·081	178	115·41	5,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester ...	230,970	4,028,542	37,073,717	9·202	·954	161	...	3,985	12·9	·712	2·18	·984	8	...	...	130
London ...	...	E 58,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·05	17,728·8	1,335	1,722
		H 636,933	6,613,781	10·38	·77	..	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16·9	·612	1·58	·633	7·5	14·40	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	..	3,102	6·4	·617	1·34	·7	...	...	..	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7·7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16/1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington...	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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NEW CONTRACTS AND ORDERS.

Derby Corporation Tramways have purchased an Edison electric tower wagon.

The J. G. Brill Company's tender for trucks has been accepted by Manchester Tramways Committee.

Dick, Kerr and Company, Limited, have an order from Stockport Corporation for a 5,000-kw. turbo-alternator.

Newport Town Council have ordered from Babcock and Wilcox, Limited, a steam feed water heater and accessories.

Messrs. Boydell and Company have an order for sub-station section pillars from the Southend Borough Council.

The Brush Electrical Engineering Company are to supply a 1,500-kw. turbine set at £6,996 to Walthamstow Council.

Bacup Town Council have ordered two transformers from Messrs. Ferranti, and 7/18 S.W.G. from the Macintosh Cable Company.

The Auto-Ticket Printing Company, Limited, of Liverpool, have an order from Rotherham Town Council for tickets at 3½d. per thousand.

South Shields Corporation have accepted the tender of Hadfields, Limited, for the supply of tramway cross-overs at Mile End and Sunderland Roads.

The British Westinghouse Company's tender for high-tension and low-tension switch gear has been recommended to the West Bromwich Town Council for acceptance.

Messrs. Edward and Son have received an order from the Glasgow Corporation Tramways Committee for a four-dial electric clock to be installed at the head office.

Bradford Tramways Committee have ordered from Messrs. William Hird, Sons, and Company, of Wyke, Bradford, 4,000 yards of grey serge at 6s. per yard for uniform clothing.

Liverpool Town Council have been recommended to accept the tender of Edison Accumulators, Limited, for a 2-ton storage battery vehicle for the use of the Tramways Committee.

Southampton Town Council have ordered from John Baker and Company, Limited, 48 steel tramway tires at £15 10s. per ton, and from the B.I. and Helsby Cables, Limited, three miles of tramway trolley wire at 8½d. per lb.

Siemens Brothers Dynamo Works, Limited.—The tender of this company for the supply of "Wotan," "Tantalum," and carbon filament lamps for Messrs. G. Thompson and Company, the Aberdeen White Star Line, has been accepted.

Messrs. J. A. Panton and Company have the Liverpool Overhead Railway contract for ferro-manganese brake blocks and castings for 1915. They have also been appointed sole selling agents of the new grade "Knoxol" car cleaner miscible with water.

Glasgow Electricity Committee have agreed to recommend the acceptance of the tender of Dick, Kerr and Company, Limited, for three 1,000-kw. rotary converter sets and two 100-kw. sets to be installed in the Fairfield Engineering Works, Govan.

Orwell Electric Cars.—Messrs. Mossay and Company, Limited, have now made arrangements for the manufacture of their cars by Ransomes, Sims, and Jeffries, of Ipswich. Messrs. Mossay are acting as selling agents for the Orwell cars in Great Britain and Ireland. Their offices are at Queen Anne's Chambers, Westminster, London, S.W.

Sheffield Electric Supply Committee have accepted the quotation of the Staveley Coal and Iron Company, Limited, for 10,000 3 in. c.i. pipes, to be delivered as required, at £6 3s. 6d. per ton. The same committee have approved the order for 100 tons of electrolytic copper wire bars to be made up into cables, as and when required, at £53 10s. per ton.

London County Council have accepted the following tenders: L. Andrews and Company, insulating materials, £463; British Insulated and Helsby Cables, Limited, and Hooper's Telegraph and India Rubber Works, electric cables, wires, and flexible cords, £50 and £750 respectively; British Thomson-Houston Company and Cryselco, Limited, electric lamps, £140 and £700 respectively.

Sydney Municipal Council.—Various tenders have been received by the Sydney Municipal Council, and the following have been recommended for acceptance: British Westinghouse Company (£6,064), 2,000-K.V.A. 33,000/5,000 volt transformers; British Westinghouse Company (£2,869), 1,000-K.V.A. and 500-K.V.A. transformers; Australian General Electric Company (£1,644), 500-K.V.A. 5,000/415 transformers; N. Guthridge, Limited (£234), motor-driven air compressor; H. P. Gregory and Company (£150), vacuum cleaners; Western Electric Company (£17,591), 33,000-volt cable. Australian newspapers state that large orders for wire have been placed by the Postmaster-General's department, and the offer of the British Insulated and Helsby Cables, Limited, for 126 tons at £10,625 has been accepted. All the wire is to be of English manufacture.

PERSONAL.

Mr. J. Collinge has been appointed station superintendent at the electricity works of Salford Corporation.

Mr. Ernest Jordan, assistant engineer, has been appointed station engineer to Northampton Corporation Tramways.

Mr. J. M. Calder, chief assistant tramway engineer of Reading Tramways, has been granted an increase in salary.

Mr. Harold Gray, borough electrical engineer at Accrington, has received a commission in the Royal Artillery, the Corporation having granted him leave of absence.

Mr. John H. Parker, chief assistant engineer of the Greenock electricity works, has been appointed chief assistant at the Croydon electricity works. There were 178 applicants for the position.

Mr. Joshua Brierley has been permanently appointed traffic superintendent of the Oldham Corporation Tramways. Mr. Brierley was appointed to the position on probation on January 4, 1913.

Mr. Hubert T. Bailey, of the firm of Stephenson, Clarke, and Company, has been elected a director of the company, in the place of Mr. J. F. S. Gooday, whose death occurred at the end of December.

Sir James Bell has been appointed chairman of the Glasgow and South Western Railway Company in succession to Mr. Patrick T. Caird, resigned. Sir Matthew Arthur has been appointed vice-chairman.

Mr. F. Dudley Docker has been appointed a director of the Metropolitan Railway Company in succession to the Hon. Francis Maclaren, M.P., who has retired on accepting a commission in His Majesty's Forces.

Mr. W. Marsh, engineer and manager of Brighton Tramways, has been granted by the Tramways Committee an honorarium of 50 guineas in respect of extra services in connection with the proposed railless traction system.

Mr. C. F. Bengough has been appointed engineer for the whole system of the North Eastern Railway, the appointment following on the retirement of Mr. C. A. Harrison from the position of engineer for the northern division.

Mr. Hugh Irwin, a sergeant in the Northumberland Hussars, has been recommended for the D.C. medal. Mr. Irwin is on the official staff of the Newcastle Corporation Tramways, and is the first tramwayman to receive this distinction.

Mr. J. H. Rider, on his retirement from the position of consulting electrical and mechanical engineer to the Central Mining and Investment Corporation, Limited, and Rand Mines, Limited, Johannesburg, will join the firm of Messrs. Preece, Cardew, and Snell. Previous to going to South Africa Mr. Rider was electrical engineer to the London County Council Tramways for nine years.

Mr. S. W. Carty has resigned his position as overhead superintendent of the Liverpool Corporation tramways department, and has been granted a commission as lieutenant in the Army Service Corps, motor traction department, where his duties are to control the workshop units attached to the anti-aircraft guns. Mr. Carty held a similar position with the Newcastle Corporation before going to Liverpool, and in both cities he has been secretary to the local automobile clubs.

Sir Robert Anderson, Bart., retired from the chairmanship of Belfast Tramways and Electricity Committee at the end of the year. Alderman Tyrrell, high sheriff, in moving the adoption of minutes of the committee at a meeting of the Corporation on January 1, said that Alderman Sir Robert Anderson had been a member of the Corporation for over 20 years, and had held its highest offices. He occupied in succession to the late Sir Daniel Dixon, the position of chairman of the Tramways and Electricity Committee for seven years. It was a matter of genuine regret to them that the alderman felt it incumbent on him owing to health considerations to relinquish the responsibility of the office of chairman, and the committee hoped that, notwithstanding his advancing years, he would be long spared to go in and out amongst them, and give them the benefit of his ripe wisdom.

Death of Mr. Edgar Allen.—We regret to record the death of Mr. Edgar Allen, which took place at Sheffield on January 28. Mr. Allen, who was 77 years of age, was the founder and chairman of Edgar Allen and Company, Limited. He had travelled widely, and was greatly interested in education and philanthropic work. He presented the University of Sheffield with its handsome library building, which was opened by the present King and Queen, when Prince and Princess of Wales, and to celebrate their visit he gave £5,000 to name a ward after the Prince of Wales in the new buildings of the Royal Infirmary, and a similar sum to name a ward in the Sheffield Royal Hospital. He also gave £1,200 to the Guild of Help for the unemployed. In 1911 he presented to the city of Sheffield a Medico-Mechanical Institute, the only one of its kind in this country, for the treatment of limbs after accidents, and over 200 wounded soldiers have received treatment at the Institute since the outbreak of war. The University library gift represented £10,000, and on the Edgar Allen Institute he spent £7,000.

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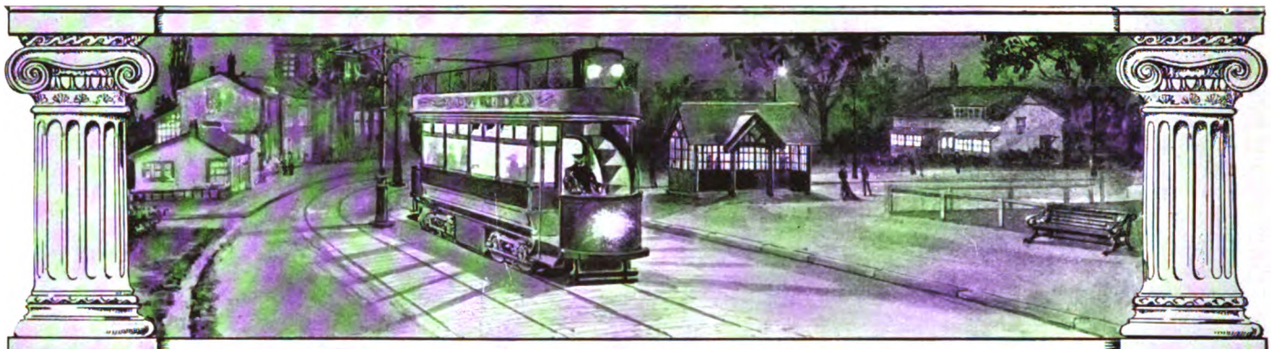

TRAMWAY AND LIGHT RAILWAY NOTES

ABERDEEN.

PURCHASE OF SUBURBAN TRAMWAYS—P-A-Y-E CARS.

The Aberdeen Tramways Committee have decided to obtain independent qualified advice as to the value of the undertaking of the Aberdeen Suburban Tramways Company before making a further reply to the company. Mr. James Dalrymple, general manager of the Glasgow Corporation Tramways, will be retained for consultation.—Mr. R S Pilcher, general manager of the Aberdeen Tramways, has reported strongly in favour of the retention of P-A-Y-E cars, which, he says, "from an operative and administrative point of view, have been an unqualified success." Fares are all collected, time-keeping is improved, accidents are reduced, and the employees' work simplified. In regard to the Mannofield route, as to which a petition has been presented against the use of these cars, Mr. Pilcher points out that the signatories amount to only 4½ per cent. of the average daily number of passengers on the route. It is apparent, therefore, that such objection as has been raised comes from only a few passengers who may on one or two occasions have been personally inconvenienced, and have not given a thought to the undoubted advantages that the system confers on passengers as a whole.

BIRMINGHAM.

EXTENSIONS—CAR LIGHTING.

At a meeting of Birmingham Corporation, Mr. Harrison Barrow, chairman of the Tramways Committee, presented a report from that body which stated that they proposed at a more suitable time to ask the Council to consider further the question of the construction of new tramways along Bristol Road to Selly Oak. Meanwhile the committee were of opinion that it would be desirable to proceed with negotiations for the acquisition of the lands on the Bristol Road route which would be required for street-widening purposes. The committee recommended that they should be authorised to acquire the lands referred to, and, if the necessity arose, to proceed with the required road widenings, on the understanding that the construction of the tramways would be deferred until the matter had been further considered by the Council. The estimated expenditure in respect of the acquisition of the lands and the carrying out of the street widenings was £41,958, which sum it was proposed to borrow. In reference to the necessity for reconstructing the Pershore Road tramway, the committee proposed, in view of the present circumstances, that the expenditure should be met to the extent of £42,000 by raising a loan. The remaining cost, £28,000, would come out of the tramways reserve fund. Both proposals were adopted. It was also resolved that a loan of £6,295 raised in January, 1912, representing the value of feeder cables in connection with the Bristol Road Tramways, should be assigned to the Electric Supply Committee, and that £3,652, the cost of cable work in connecting the Court Road sub-station to the Bristol Road tramways, should be borrowed, the loan being assigned to the electric supply department.—Since the lighting of the cars has been dimmed, complaints have been received that the direction letters have been obliterated, with the result that intending passengers cannot tell the route of the approaching car. In order to get over the difficulty the committee propose putting route numbers on the tinted headlights of the cars, these numbers to correspond with the various routes. The route number will be conspicuously shown in each car and, moreover, cards showing the whole series of numbers and the routes to which they respectively apply will be distributed among the passengers.

BLACKPOOL.

WEAR OF TROLLEY WIRE.

Blackpool Tramways Committee are renewing about nine miles of overhead trolley wire. At a recent meeting of the Tramways Committee a piece of wire, one yard in length, which had been in use on the Lytham Road for 12 years, was shown. It weighed 9½ ounces, having lost in that period 55 per cent. of its weight.

CARDIFF.

TRAMWAY EMPLOYEES' WAGES—DAMAGES ACTION.

At a recent meeting of the Cardiff Corporation tramway employees, the following resolution was unanimously carried: "That, in consequence of the enormous increase in the cost of living, this mass meeting of Cardiff tramwaymen, representing 95 per cent. of the employees, instructs our branch secretary to apply to the Tramways Committee for an immediate advance of 1d. per hour, the weekly amount of which, according to official returns, will be equivalent to the increased cost of living since the declaration of war."—A case of some interest has now been decided by Judge Hill Kelly in Cardiff County Court. It had been remitted from the High Court because the plaintiff was unwilling to give security for costs. Mrs. Kate Benjamin, a widow, claimed £300 damages against Cardiff Corporation in respect of personal injuries sustained in a tramcar accident on April 14 last year. For the plaintiff it was stated that she was coming down the stairs from the upper deck of a car in order to get off at a stopping place, when the conductor signalled for the car to start. It started with a jolt, with the result that she fell to the platform and her leg was fractured. For the defence, the conductor said that the car was at a standstill when the plaintiff fell. She smelt rather strongly of drink. Witnesses for the plaintiff, on the other hand, testified that she showed no signs of having had anything to drink. She herself said that all she had to drink before the accident was one glass of stout. The judge said that without suggesting that there was any ground for making any allegation that the plaintiff was under the influence of drink, he had come to the conclusion that she had failed to establish that it was because the car moved on that she fell. She had failed to show that there was any negligence on the part of the servants of the Corporation, and he, therefore, gave judgment for the defendants.

COLCHESTER.

PROTECTION FOR TRAMCAR DRIVERS.

Alderman Cant, speaking at a recent meeting of the Colchester Town Council, said that during a heavy rainstorm he had been allowed to stand beside the driver on a crowded car, and he then realised how much exposed drivers were to bad weather. He suggested that some form of screen should be used so that the driver would have some protection without having his view obstructed.

DARLINGTON.

NEW PLANT.

At the January meeting of Darlington Town Council the Electricity Committee recommended that tenders be invited for the supply of a 2,000-KW. and a 3,000-KW. generating set, and that application be made to the Local Government Board for sanction to borrow £18,550 required for extension of the power-station. The recommendations were approved.

DONCASTER.

NEW CARS AND CAR SHED EXTENSION.

Doncaster Town Council have agreed to make application to the Local Government Board for sanction to borrow money for the purchase of six new tramcars estimated to cost £5,500, and for the erection of a new car shed at a cost of £1,850.

GLASGOW.

A SINGULAR ACCIDENT.

In the Court of Session, Edinburgh, on January 22, Mrs. Ellen Campbell or Miller sued the Corporation of Glasgow for £250 damages in respect of personal injuries. The pursuer stated that on June 11 last she was proceeding along the passage on top of one of defenders' cars, when it stopped with a violent jerk. She was thrown forward, and her head went through a glass panel. She attributed fault to the defenders, in that the car was being driven at excessive speed, and was not under proper control. It was stated on behalf of the defenders that the driver pulled up to avoid running over a dog. After an absence of 15 minutes the jury returned a verdict for the pursuer, and awarded £150 damages.

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HAMILTON.

THE FAULT OF THE PASSENGER.

At Hamilton Sheriff Court, Scotland, on January 20, a judgment of considerable importance to tramway managers was given by Sheriff Shennan. A young woman sued the Lanarkshire Tramways Company for £20, in respect of injuries sustained by her when entering a car at Burnbank She had boarded the car, and was ascending the stair leading to the top, when the car jerked suddenly forward, and she was thrown over the back end of the car into the roadway, sustaining severe injuries. Pursuer alleged negligence on the part of the car driver. On the evidence, the Sheriff concluded that the accident was one for which no one was responsible. The car was in motion and had gone its own length before the jerk took place, which was alleged to have been the cause of the accident. His lordship had no doubt that the pursuer lost her balance when moving her hand to get a higher grip as she was ascending the stair of the car. The case was ruled by the decision in Goldberg *v.* the Glasgow and South Western Railway, in which Lord Maclaren pointed out that a passenger was supposed to be able to take care of himself when within a carriage in which he is travelling. Every traveller by tramcar knew that he was liable to jerks in the course of the journey, and must take the requisite precautions when moving about the car when it was in motion. There was no rule that the car was not to start till all the passengers were seated. While one had much sympathy with the pursuer, her injuries were plainly due to her accidental failure to steady herself in ascending the stair. His lordship granted absolvitor.

ILFORD.

HALFPENNY FARES.

Ilford Town Council has instructed the tramways manager to prepare a comprehensive report on the experience of tramways which have abandoned halfpenny fares and adopted universal penny fares. The manager had previously reported that the Ilford tramways would always be a greater or less burden on the rates as long as halfpenny fares were continued. Last year there was a loss of about £3,500, which was mainly attributed to the omnibus competition.

LEICESTER.

LIGHTING TRAMWAY ROUTES.

The Leicester Watch Committee have adopted a unanimous recommendation of the Lighting Sub-committee in favour of electric light for the lighting of tramway routes generally. During the past two years the Lighting Sub-committee have been considering the relative merits of gas and electricity for use in lighting the principal streets, and experiments have been made with a high-pressure gas system and with suspended central electric lights on the recently constructed tramway in King Richard's Road.

LLANDUDNO.

ADVANTAGES OF TRAILER CARS.

The Board of Trade some time ago authorised the use of trailer cars by the Llandudno and Colwyn Bay Electric Railway, Limited. Alluding to the matter at a recent meeting of the company, the chairman remarked that the use of trailer cars would be of much assistance to them in dealing with rush traffic in the summer season.

LONDON.

LOSS DUE TO ACCIDENT AT GREENWICH STATION—LAST HORSE TRAMWAY.

For the week ended December 16, which included the period during which the London County Council tramway service was interfered with by the accident at Greenwich generating station on December 11, the traffic receipts amounted to £36,760. In the corresponding week of the previous year the traffic receipts were £43,151, showing a derease of £6,391.—The last of the old horse tramways of the London County Council, which have been diminishing in number since the electrification of the Westminster-Tooting line in 1903, is about to disappear. The Council has sanctioned the expenditure for the widening of roads required for the electrification of the horse tramway from Tower Bridge to Rotherhithe. This route is about two miles in length, and the cost of the electrical equipment on the conduit system will be about £74,700, an average cost of £37,000 per track-mile, exclusive of the cost of the street widening. The London County Council would have preferred to install the overhead trolley system, but the Bermondsey Borough Council insisted on the more expensive conduit system.

MANCHESTER.

PARCELS TRAFFIC—ALL-NIGHT CARS—A LESSON.

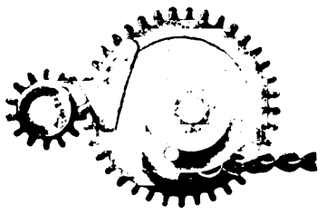
The popularity of the parcels department of the Manchester tramways is shown in the returns of the Christmas traffic. On the six days before Christmas 42,840 parcels were carried, yielding a revenue of £473 16s. 11d., compared with 47,603 parcels and £522 13s. 9d. on the corresponding days in the previous year. The figures for the corresponding days of the four years prior to the last-mentioned record were: 1909, parcels carried, 28,767, revenue, £314; 1910, 31,892 parcels and £348 5s. 4d. revenue; 1911, 37,081 parcels and £406 18s. 9d. revenue; and 1912, 47,603 parcels and £522 13s. 9d. revenue.—The Manchester Tramways Committee have decided to continue all-night cars without alteration for another 12 months,

Note the STOPS which form the special feature of The "Peacock"

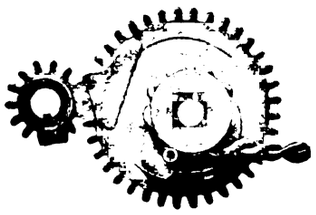
IMPROVED BRAKE

(Patent).

and by preventing the drum from over-running on release, save three quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



WINDING.

"PEACOCK" BRAKES

(PATENT)

Have been supplied to the following Tramways amongst others:

MANCHESTER - -	698
BIRMINGHAM -	458
SALFORD - - - -	428
METROPOLITAN - -	278
CROYDON - - - -	150
HASTINGS - - -	130
WAKEFIELD - - -	130
RHONDDA - - - -	108
NOTTINGHAM - - -	100

NOTE.—The stops being cast solid with the wheel and pinion in no way detract from the Simplicity of the Brake nor increase the cost of maintenance.

The "PEACOCK" BRAKE CO., 27, Clements Lane, LONDON, E.C.

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although there has been a loss on their working. Since the outbreak of war the tramway receipts have been much reduced, but the situation is improving. During the past few weeks the receipts have exceeded those of the corresponding weeks of last year.—Tramway drivers and conductors, as well as officers, should note the facts reported at a Stockport inquest regarding the death of a Manchester car conductor named Hugh Dalton. The kind of accident is one which may occur in sheds and depots, as well as in the streets. The report of the inquest is to this effect: When the car on which Dalton was guard reached Mersey Square something went wrong with the trolley. A Stockport car came up to within a few feet of the Manchester car, and as soon as Dalton let go the trolley rope, and the trolley head touched the wire, the Manchester car moved back, and Dalton was crushed between the cars. The driver of the Manchester car said he thought Dalton must have touched the power handle of the car. A verdict of accidental death was returned, and the jury declared that there was no one to blame. The Coroner said he had known Dalton for 20 years, and he was one of the best guards in the Manchester tramway service. From the above it is quite evident that while the trolley was off the line someone moved the controller handle to the on position, and apparently the reverser had also been used, seeing it is said that the car ran back. Accordingly, as soon as the trolley was replaced on the wire, the car started. No precautions can be too elaborate to prevent the inadvertent starting of cars when men are in positions which are dangerous if the cars move.

NEWCASTLE.

New By-Laws.

By the Newcastle Corporation Act, 1914, the Corporation is authorised to run reserved cars on special occasions at such fares as they think fit. A new by-law which the Board of Trade is willing to approve enables the accommodation on the reserved cars to be kept exclusively for the persons for whose use they are provided. The reserved cars are to be distinguished by a notice conspicuously displayed indicating that they are reserved, and under the new by-law persons who do not dismount can be removed from the reserved cars.

POTTERIES.

Company's Tenure.

Much local agitation has been going on regarding a proposal for an extended tenure to the Potteries Electric Traction Company. If the scheme is carried out an agreement will be entered into between the company and the six towns concerned, and the proposed agreement has met with opposition, especially from the Labour party. The company's rights over the tramway system, from Goldenhill to Longton, on the main highway of the six towns, expire in 1917, and six months' notice must be given by the Corporation to exercise the option of purchase. The light railways which are generally in the outlying districts do not fall in until 1932. The principal terms of the proposed new lease give the company extended running powers until 1940, and provide for a payment to the Corporation of £2,000 a year for the first 13 years, and £3,000 a year for the last 13 years, as wayleaves. The company also undertake to spend £35,000 in improving rolling stock, etc., to double lines on certain sections of the route, and to construct additional loops.

SALFORD.

Car Shed Extension.

The Tramways Committee have recommended that application should be made to borrow £6,550 for expenditure in connection with the proposed extension of the central car depot at Pendleton.

SHEFFIELD.

Physical Standard for Conductors—Car Services.

Sir William Clegg, chairman of Sheffield Corporation Tramways Committee, replying to a question at a recent meeting of the City Council, said that there had been no special height required for conductors, but they had unfortunately now arrived at a time when it was necessary that every man accepted for the position of conductor should be physically capable of taking up the work of a motorman. The standard height for a motorman was 5 ft. 7 in., and the applicants must be able to pass the medical examination before being accepted by the department. Owing to the large number of men who had volunteered for service, the committee were very short of men. They were continually training new men, and at the present time they actually had more cars working in the evenings than was the case in July, while the daily service was being rapidly brought up to the previous standard. They hoped very shortly to have a satisfactory service on all routes. The employees had loyally worked a considerable amount of overtime, and the Council was much indebted to them for the manner in which they had assisted the undertaking.

SOUTH SHIELDS.

Proposed Purchase of Jarrow Light Railway.

The South Shields Corporation Tramways Committee are taking steps to acquire the Jarrow and South Shields light railways, which are useful feeders of the borough tramways. A deputation will probably be sent to the Jarrow Corporation to discuss the matter and ascertain Jarrow's views upon the scheme.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

Applications.

The following Applications for Letters Patent have been filed:

24,382 Signalling apparatus for motor vehicles—V. Louis.
24,392 Signalling system for controlling traffic in streets—E.W. Kelley.
24,397 Guards for tramcars—F. W. Hills.
24,461 Fish plates for rails—F. C. Lynde.
24,487 Car couplings—L. Olivero.
24,540 Car trucks—W. S. Adams.
24,657 Train-control apparatus—A. Kerr.
24,686 Motor vehicles W. Youlten.
24,751 Bolts for railroad connections—E. I. Dodds.
24,787 Electro-magnetic circuit-controlling devices for railway signalling—J. Gardner.
24,820 Rail joints M. Such.
71 Automatic safety devices for omnibuses, etc.—B. Gelman.
92 Life-guards for motor vehicles—W. Harvey and W. E. Archer.
139 Automatic railway switches—A. J. Gurney.
343 Base plates for railway or tramway sleepers—C. P. Sandberg.
356 Under frames for railway vehicles—H. Wade *(L. N. Lloyd)*.
397 Automatic stopping apparatus for railway trains—E. C. Irving.
418 Chassis for chain-driven motor vehicles—J. R. Churchill.
420 Automatic circular cam-grip railway chair—J. E. Mears.
429 Brakes for use on wheels of motor road vehicles—H. W. Alden.
489 Supporting and joining the ends of railway rails—W. R. Arnold.
491 Electric motor control systems British Thomson-Houston Company, Limited *(General Electric Company)*.
504 Driving and steering mechanisms—H. G. Smith.
527 Nut-locking mechanisms for rail track fish plates—P. Nosted.
775 Rail-holding chairs D. Skinner.
837 Motor road vehicles—Burrelli, Limited, and A. Courtney.
928 Fluid-pressure braking apparatus—J. W. Cloud.
1,013 Apparatus for use in connection with steam superheaters on locomotives—J. G. Robinson.
1,078 Railway switch operating devices—A. J. Joest and P. Hansen.
1,191 Air brake apparatus W. G. Canion.
1,192 Automatic train stops S. Rogers.
1,317 Means for actuating brakes or other mechanism on moving vehicles from controlling apparatus on the permanent way—F. Alcock.
1,340 Central station generating plant British Thomson-Houston Company, Limited, F. H. Clough, and F. Samuelson.
1,428 Electrical motor vehicles—P. A. H. Mossay and Mossay and Company, Limited.
1,518 Anti-rain seat for tramcars—D. Correia.
1,541 Locomotives—A. Bykovetz.

Specifications Published.

1913.

28,739 and 28,740 Automatic car couplers—Willison and National Malleable Castings Company.
28,761 Power-driven vehicles Templer.
28,821 Automatic car couplers—Willison and National Malleable Castings Company.
27,196 Apparatus for controlling trains—Jenkins.
29,260 Electrically-insulated fish joints for rails—W. R. Sykes Interlocking Signal Company and Sykes.
23,520 Railway signals Fisher.

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28,703 Automatic control for electric railways—Hutches.
29,752 Electric motor control systems—British Thomson-Houston Company *(General Electric Company)*.
30,083 Electric motor control—British Thomson-Houston Company and Hastings.
30,090 Railway vehicles—Walker.
21,513 Railway signalling devices—Whitton and Tayler.

1914.

5,377 Hand-operated brakes for tramcars—Bardsley.
10,619 Traversers for electric railways—Mullaney.
17,716 Quick-action release valves for vacuum brakes—Nothin.
471 Sanding arrangements for railway purposes—Millington.
5,926 Metallic railway sleepers—Harris.
8,069 Rail joints and crossings—Wightman.
8,295 Sanding apparatus for tramways—Webster and Sidgwick.
13,845 Automatic adjuster for the brakes of railway vehicles—Rose.
15,483 Keys for fixing railway rails—Wolff.
224 Railway coaches—Metropolitan Carriage, Wagon, and Finance Company and Wigley.
2,066 Rail joints—Stephenson.
5,609 Motor road vehicles—Daimler Company and Berriman.
16,702 Railway points or switches—Steedman.
720 Car seats—Morton.
3,657 Collapsible roof for the deck of omnibuses or tramcars—Beck.
7,019 Signalling on trains—Benn.
163 Wind screens for tramcars—Hosken.
380 Vacuum automatic brake apparatus—Luard.
2,298 Apparatus for applying the brakes of railway vehicles independently of the driver—Kelway-Bamber.
3,559 Brakes—Marshall and Penman.
5,443 Chairs for railway rails—Davies and Morgan.
10,948 Electric railways—White *(Sturges)*.
11,403 Rail joints—Wait and Halliday.
16,367 Railway rails—Bagley.
99 Driving mechanism of motor road vehicles—Wolseley Motors, Limited, and Remington.
749 Supports for electric trolley wires—Von Kando.
1,309 Life-guards for tramcars—Philipson, Philipson, and Philipson.
1,530 Bogies for railway rolling stock—Timmis.
1,578 Signalling devices for railroads—Leigh and Swainson.
8,300 Gauges for the permanent way—Barnhill.
9,274 Rails for tramways and railways—Burkill.
11,355 Points for tramways and railways—Edgar Allen and Company and Larmuth.
11,583 Rail joints—Williams.
12,432 Automobile brake mechanism—Daimler Co. and Berriman.
14,098 Current collectors for electric tramways—Compagnie Générale des Omnibus de Paris.
14,281 Metallic railway ties—Hyle, Von Dorn, and Ames.
17,727 Railway spikes—Fischer.
18,755 Car axles—Randall.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.		1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
		Jan. 3.	Jan. 10.	Jan. 17.	Jan. 24.	Jan. 31.	Jan. 2.	Jan. 9.	Jan. 16.	Jan. 23.	Jan. 30.	Wks.	1915.	Increase or Decrease.
		£	£	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine		68.194	52.720	58.200	56.621	55.023	58.098	58.067	51.491	49.823	48.728	4	202.762	– 25.149
Auckland		...	(28 days)	25.633	...	...	...	(28 days)	22.164	...	...	28	147.096	+ 11.558
Calcutta	Rs.	71,942	71,162	69.754	68,040	64.474	60,748	66.127	66.577	61.088	62.326	5	3,16.866	– 2.148
Hong Kong	$	...	10.772	11.301	12,633	15.176	...	9.873	9.334	9.340	9.506	5	48.314	– 12.734
Madras	Rs.	(2 weeks)	29.303	(2 weeks)	28.836	...	(2 weeks)	28.435	(2 weeks)	28.951	...	4	57.386	– 753

Companies Issuing Monthly Statements.

		1913					1914.	1914.					1915.	Wks.	AGGREGATE.	
		Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.		1915.	+ or –.
		£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.		...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
BrazilianTraction Mlrs		...	6.028.078	6.098.850	6.009.487	...	..	...	6.096.940	6.241.170	5.929.730	...	...	47	67.340.988	+ 1.408.836
Brisbane		29.970	...	27.250	27.053	29,145	...	33.172	...	28.763	28.600	30.890	...	52	348.111	+ 31.895
British Columbia	$	770.628	734.283	753.541	746,152	...	...	674.812	650.516	661.000	648.485	...	...	21	3.324.836	– 435.671
Buenos Aires Pt. & C.		...	..	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze		...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town		...	...	12.223	...	14,147	...	...	...	12.682	...	15.869	...	—	—	—
Carthagena & Herrerias		2.192	1.344	1.582	1.922	2,698	2.776	2.758	2.175	1.543	1.379	1.255	904	4	904	– 1.872
Cordoba		13.691	13.343	13.278	...	12.863	...	13.371	12.384	12.919	...	12.119	...	39	119.457	– 845
East India		2.005	2.028	1.878	1.922	2.046	1.938	2.112	1.980	2.007	2.029	1.839	1.914	26	11.881	+ 64
Kalgoorlie		3.357	3.068	2.652	2,504	...	...	3.042	2.864	2.525	2.414	...	...	48	28.919	– 2.684
La Plata		...	4.528	4.920	5.409	5.505	5.296	...	4.190	4.540	4.540	4.452	4.540	4	4.540	– 756
Lima		33.939	34.177	35.175	33.236	38.091	...	29.800	28.786	30.648	29.749	32.112	...	52	392.981	– 14.203
Manila	$	...	138.000	148.000	154.950	154.000	...	...	116.300	125.750	129,000	132.500	...	52	1.603.565	– 97.492
Melbourne		...	61.969	65,000	...	...	...	...	58.664	63.328	61.589	...	...	—	—	—
Mexico	$	635.445	604.744	616.007	605,467	...	...	687.593	667.421	558.990	643.961	...	...	47	6.716.716	+ 378.911
Montevideo		...	...	...	30.531	33.310	38.256	...	...	...	27.081	28.605	32.443	13	88.129	– 13.967
Port Elizabeth		...	...	3.553	...	4.367	...	...	...	3.372	...	3.986	...	—	—	—
Puebla	$	52.900	51.100	63,000	69,700	...	...	50.500	52.200	49.100	45,900	...	...	47	629.500	– 18.900
Rangoon		...	5.054	5.963	5.686	5,424	...	...	4.119	4.600	4.405	4.459	...	52	59.521	– 3.188
Toronto	$	850.222	865.796	861.235	849.279	...	...	850.639	879.321	849.636	824.634	...	...	47	9.296.377	+ 402.393
Winnipeg	$	340.507	331.732	357.313	360.082	...	...	322.762	310.996	330.562	330.398	...	...	47	3.732.901	+ 34.070

(*Continued on page 120*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.					1915. WEEKS ENDED.				AGGREGATE.		
	Jan. 3.	Jan. 10.	Jan. 17.	Jan. 24.	Jan. 31.	Jan. 2.	Jan. 9.	Jan. 16.	Jan. 23.	Jan. 30.	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation ...	1.640	1.861	1.459	1.371	1.363	1.588	1.947	1.560	1.500	1.485	32	58.116	+ 1.520
Accrington Corporation ...	598	477	516	512	528	555	515	480	478	447	43	23.063	- 1.798
Ayr Corporation ...	276	244	208	211	231	248	253	214	211	207	37	13.267	- 1.098
Bath Electric ...	885	695	692	641	642	823	647	642	652	616	4	2.557	- 113
Birkenhead Corporation ...	1.357	1.217	1.142	1.136	1.411	1.263	1.233	1.218	1.187	1.137	43½	56.905	+ 1.946
Birmingham Corporation ...	11.986	12.215	11.841	11.762	12.127	12.913	12.399	12.189	12.172	11.970	44	533.692	+ 11.419
Blackburn Corporation ...	1.322	1.299	1.106	1.006	1.070	1.281	1.220	981	1.012	1.013	44	55.485	- 1.798
Blackpool and Fleetwood ...	459	258	243	234	236	431	290	260	267	263	4	1.246	+ 42
Blackpool Corporation ...	811	572	459	429	461	833	734	610	571	546	44	69.781	- 9.061
Bolton Corporation ...	3.314	2.557	2.457	2.486	2.719	3.170	2.567	2.482	2.385	2.437	44	118.594	- 2.011
Bournemouth Corporation ...	1.624	1.492	1.394	1.431	1.568	1.859	1.700	1.708	1.613	1.609	44	88.664	- 2.599
Bradford Corporation ...	5.466	5.350	5.728	5.286	5.435	6.125	5.837	6.021	5.680	5.554	44	270.310	+ 10.996
Brighton Corporation ...	807	796	729	658	765	851	887	842	778	744	43½	47.664	- 215
Bristol	8.624	7.735	7.318	6.773	7.037	10.124	8.832	8.382	7.587	7.789	4½	33.950	+ 2.760
Burnley Corporation ...	1.591	1.618	1.595	1.481	1.614	1.483	1.519	1.419	1.406	1.376	44	67.034	- 7.795
Burton-on-Trent Corporation	299	292	270	260	278	311	294	281	258	259	44	13.018	+ 174
Bury Corporation	1.361	1.167	1.261	1.155	1.257	1.275	1.172	1.188	1.143	1.109	43½	58.784	- 482
Cardiff Corporation ...	2.567	2.579	2.395	2.338	2.532	2.722	2.533	2.485	2.393	2.305	43	119.038	- 642
Chatham and District ...	779	928	795	746	737	969	970	969	945	859	4	3.744	+ 538
Chesterfield Corporation ...	278	239	237	237	243	260	251	248	243	234	43	11.601	+ 307
Colne Corporation... ...	232	222	228	167	239	207	209	207	198	189	—	—	—
Cork Electric	341	459	434	400	428	416	515	427	422	407	4	1.714	- 62
Croydon Corporation ...	1.517	1.504	1.459	1.354	...	1.661	1.670	1.589	1.431	...	42	72.772	+ 2.463
Darlington Corporation ...	267	236	233	226	238	281	260	241	238	229	44	11.515	+ 544
Derby Corporation ...	967	936	875	851	901	1.059	960	914	901	874	43½	43.930	+ 816
Dover Corporation ...	200	189	171	163	177	260	249	247	235	226	45	11.193	+ 431
Dublin and Lucan ...	267	149	110	101	106	283	136	109	111	107	4	463	- 4
Dublin United ...	...	5.235	4.973	4.808	5.154	...	5.821	5.695	5.506	5.188	4	23.071	+ 2.195
Dundee City	1.333	1.527	1.183	1.194	1.191	1.265	1.557	1.206	1.178	1.157	36½	47.365	- 927
East Ham Corporation ...	990	963	993	1.005	1.025	1.253	1.306	1.234	1.162	1.147	43½	52.033	+ 7.553
Exeter Corporation ...	309	297	269	245	273	378	341	317	295	272	44	15.405	+ 443
Gearless Motor 'Buses ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation ...	23.026	19.985	19.324	19.377	20.158	21.857	21.095	19.688	19.969	19.606	34	706.548	- 2.399
Glossop (Urban Elec. Supply Co.)	111	120	110	120	129	112	108	109	104	101	5	534	- 57
Halifax Corporation ...	2.292	2.000	1.774	1.838	1.823	2.383	2.025	1.925	1.930	1.884	43	94.340	+ 3.147
Hastings and District ...	1.070	724	640	609	616	956	714	778	701	598	4	2.792	+ 202
Huddersfield Corporation ...	2.011	1.968	1.970	2.033	2.061	2.474	2.343	2.311	2.336	2.179	44	123.511	+ 10.479
Hull Corporation	3.388	3.223	3.249	3.132	3.140	3.266	3.120	3.073	2.960	2.946	44	135.994	- 3.183
Ilford U.D. Council ...	419	428	395	380	417	677	602	577	533	539	43	25.129	+ 5.467
Ilkeston Corporation ...	116	119	117	117	126	108	111	111	106	109	44	5.620	- 312
Ipswich Corporation ...	396	369	335	325	247	441	391	382	367	237	44	19.743	- 152
Isle of Thanet	303	276	250	237	260	289	269	276	237	216	17	5.414	- 687
Kilmarnock Corporation ...	247	167	137	152	161	204	167	143	142	140	37	6.014	- 563
Lanarkshire	1.571	2.643	1.645	1.667	1.645	1.826	2.539	1.668	1.715	1.658	4	7.401	- 200
Lancashire United ...	1.648	1.671	1.401	1.438	1.498	1.661	1.772	1.440	1.491	1.445	4	5.922	+ 52
Leeds City	7.723	7.807	7.596	7.572	7.996	8.491	8.083	8.186	7.925	7.710	44	361.938	+ 8.112
Leicester Corporation ...	2.830	2.762	2.696	2.615	2.714	3.145	2.910	2.823	2.776	2.764	5	12.271	+ 782
Leith Corporation... ...	778	675	641	628	655	723	697	640	627	633	37	26.524	+ 141
Leyton U. D. Council ...	1.366	1.293	1.275	...	...	1.453	1.451	1.499	...	...	40½	57.069	+ 2.693
Liverpool Corporation ...	12.749	12.884	12.322	12.168	12.643	12.936	12.849	12.411	12.383	11.896	4	53.572	- 602
Llandudno and Colwyn Bay ...	182	145	139	136	139	199	175	167	168	163	8	1.367	+ 165
London County Council ...	40.512	41.678	41.749	40.633	40.062	44.688	46.543	46.191	46.249	41.714	43	1,915.433	+ 93.689
London General Omnibus...	*	...	...	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation ...	182	167	163	157	153	177	159	160	144	138	17	2.994	- 267
Maidstone Corporation ...	201	171	167	159	154	173	181	161	155	139	44	8.999	+ 61
Manchester Corporation ...	16.812	16.758	16.556	16.348	17.076	17.161	16.759	16.580	16.547	16.015	44	753.304	- 14.031
Metropolitan Electric Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
National Steam Car	4.482	3.432	3.409	3.377	...	4.135	3.023	3.292	3.193	...	11	39.044	- 2.980
Nelson Corporation	219	181	185	201	177	153	160	154	145	159	43½	8.001	- 1.188
Newcastle-on-Tyne Corporation ...	5.132	4.816	4.874	4.751	4.972	5.977	5.720	5.719	5.584	5.599	44	242.446	+ 26.267
Newport (Mon.) Corporation ...	745	740	692	673	739	802	768	754	707	693	44	35.431	+ 1.617
New St. Helens and District ...	821	723	683	672	686	952	883	784	809	786	30	27.919	+ 2.710
Northampton Corporation... ...	587	523	503	483	502	659	582	564	541	531	43½	25.994	+ 788
Nottingham Corporation	3.462	3.166	3.218	3.165	3.230	2.916	3.371	3.313	3.296	3.230	43½	149.049	+ 3.161
Oldham Corporation	2.085	2.086	2.071	2.081	2.096	2.068	1.931	2.070	1.985	1.937	45	97.061	- 2.152
Portsmouth Corporation ...	1.934	2.016	1.698	1.615	1.735	2.155	2.244	2.159	1.993	1.997	44	104.423	—
Preston Corporation	866	846	817	787	772	834	817	897	884	822	44	39.836	+ 1.005
Provincial...	1.762	1.720	1.641	1.590	1.558	1.974	1.909	1.932	1.813	1.791	16½	33.474	+ 3.471
Reading Corporation	745	665	637	590	645	679	736	701	619	623	43	30.736	+ 408
Rochdale Corporation	1.502	1.415	1.462	1.425	1.475	1.539	1.499	1.491	1.442	1.403	44	70.414	+ 61
Rhondda Tramways	1.351	1.093	1.102	1.095	...	1.312	1.094	1.098	1.102	...	3	3.295	+ 4
Rotherham Corporation ...	1.022	950	957	957	1.071	1.003	923	942	914	935	44	45.225	+ 455
Salford Corporation	5.164	4.893	4.935	4.630	5.071	5.080	4.640	4.740	4.583	4.480	43	217.972	- 11.412
Sheffield Corporation ...	7.712	7.447	7.322	7.377	7.673	8.398	7.966	7.917	7.767	7.803	44½	346.738	+ 9.767
Southampton Corporation... ...	1.027	1.188	1.174	1.107	1.075	1.180	1.285	1.213	1.187	1.166	43	57.403	+ 127
Southend-on-Sea Corporation ...	648	648	610	607	583	601	609	606	616	551	43	42.966	+ 1.811
South Metropolitan Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
South Shields Corporation ...	781	643	650	658	670	772	728	656	659	638	43½	33.150	+ 1.635
Sunderland Corporation	1.594	1.283	1.270	1.357	1.421	1.539	1.304	1.282	1.302	1.245	44	64.273	+ 562
Swindon Corporation	169	136	158	133	136	207	172	168	162	151	43	7.767	+ 579
Torquay Tramways	464	401	341	341	...	459	435	411	370	...	3	1.217	+ 133
Tramways (M.E.T.) Omnibus Co. ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	508	459	422	446	...	567	435	492	493	...	—	—	—
Wallasey Corporation	1.114	1.127	1.059	1.017	1.070	1.110	1.113	1.059	1.030	989	43½	54.288	+ 841
Walsall Corporation	636	596	579	576	629	749	651	697	654	637	5	2.862	+ 191
Walthamstow U.D. Council ...	694	689	651	624	656	770	725	715	704	684	44	35.240	+ 2.696
Warrington Corporation	463	429	412	407	428	410	439	423	421	402	43	18.896	- 463
West Ham Corporation	2.636	2.645	2.605	2.489	2.478	2.640	2.840	2.841	2.760	2.482	43	122.702	+ 4.656
Wigan Corporation	1.570	1.379	1.385	1.398	1.422	1.397	1.387	1.383	1.401	1.296	43	63.127	- 1.824
Wolverhampton Corporation ...	1.014	1.031	964	962	1.108	1.061	1.032	1.026	962	1.001	45	46.766	- 1.411
Yorkshire (West Riding)	1.324	1.336	1.368	1.381	1.469	1.505	1.409	1.434	1.353	1.337	5	7.038	+ 160

* Publication of Traffic Returns suspended during the war.

ELECTRIC RAILWAY TRAFFIC RETURNS.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

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A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officials and the principal particulars relating to each undertaking.

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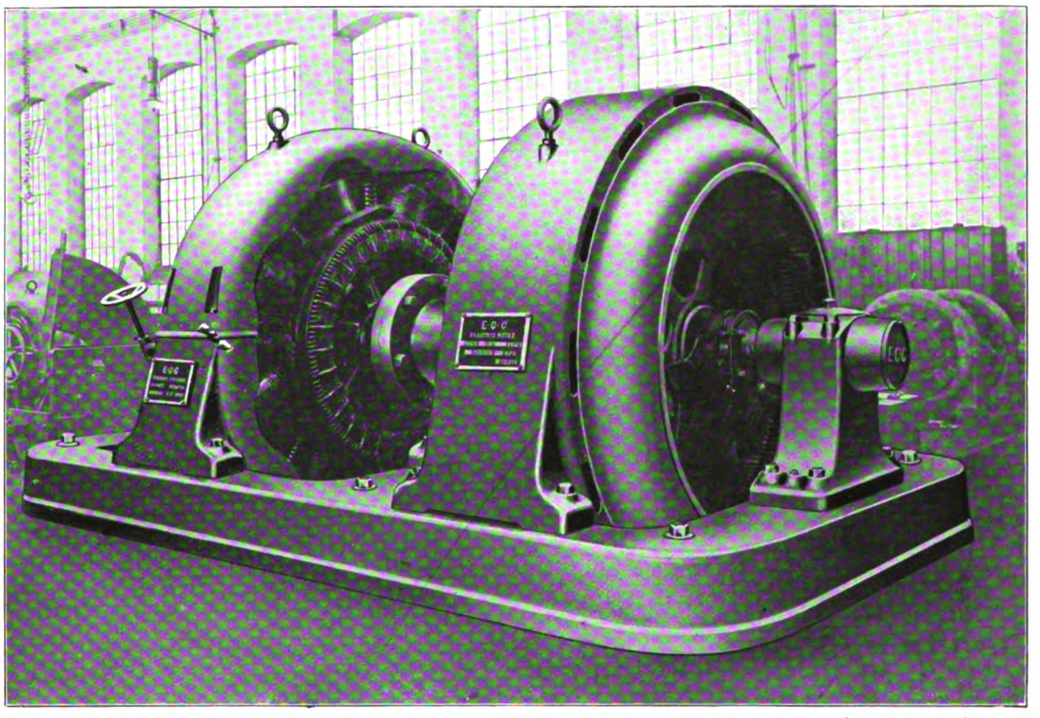

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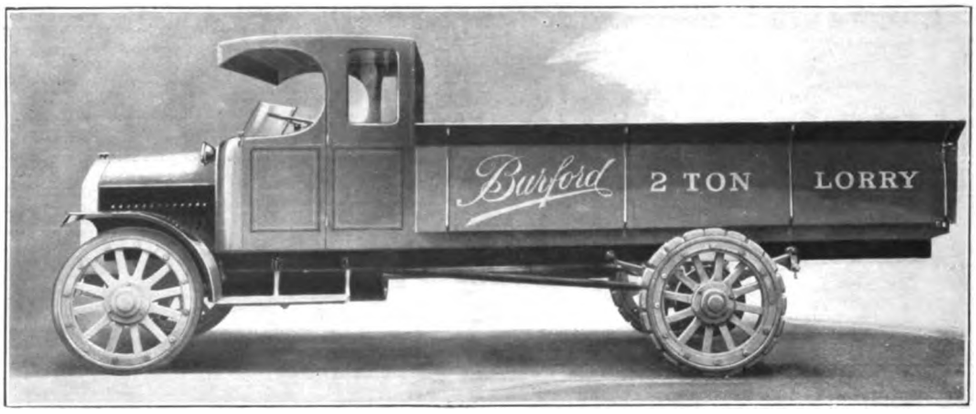

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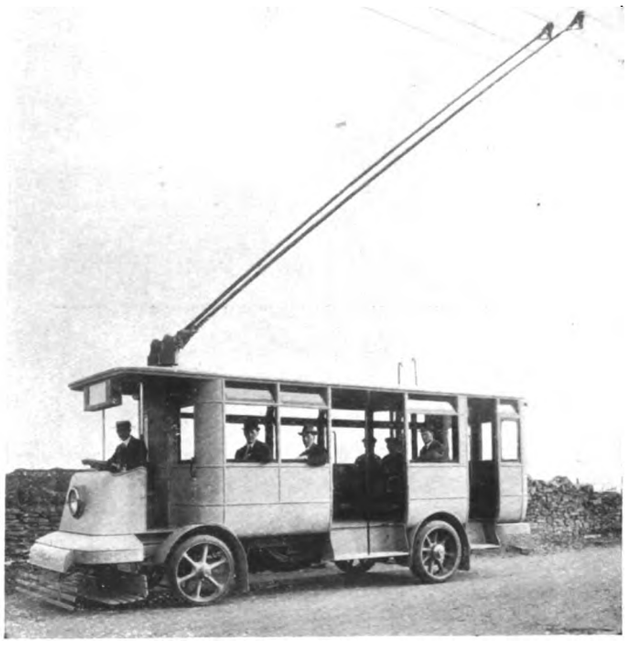

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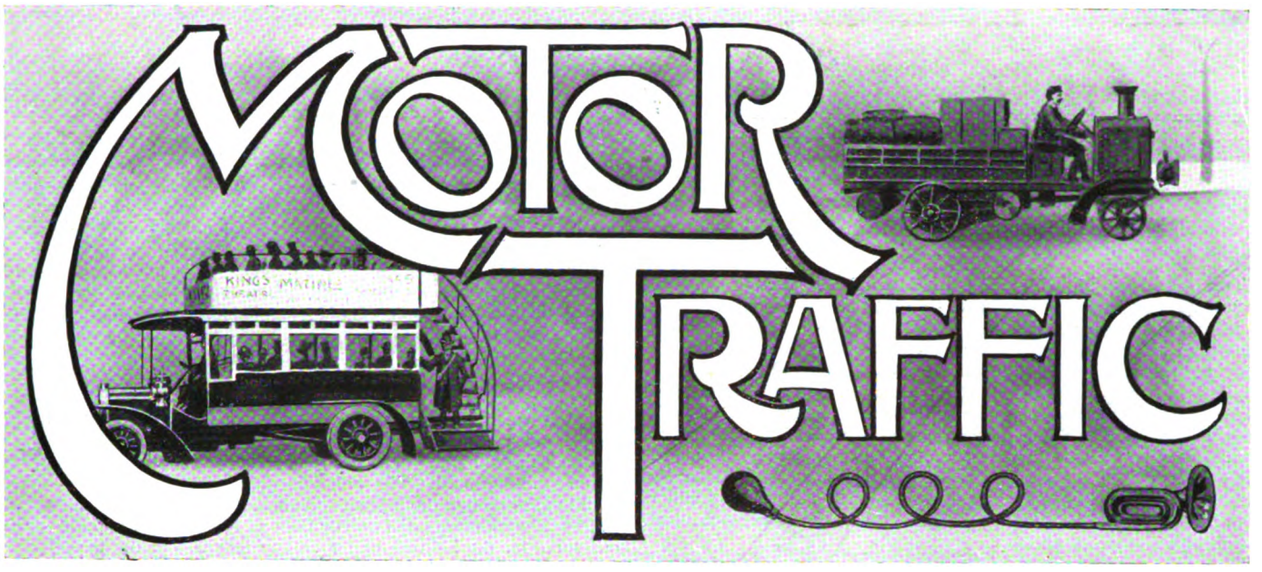

While in certain ways there is danger of the war adversely affecting the ultimate interests of the British heavy motor industry, there are others in which beneficial influences are evident. It has often been said that the British vehicle is built to work on such good roads as to make it unsuitable for general service conditions in the Colonies. Present experience is disproving the truth of any such allegation. At the same time, makers have perhaps in the past acceded too readily to the trader's demand for a lorry with very low platform to facilitate loading and unloading. This has meant small ground clearance and small wheels. Before the war there were distinct symtoms of trouble from this cause. Those responsible for the maintenance of the roads have fair grounds for objecting to the carriage of heavy loads at high speeds on wheels of very small diameter. It is in the best interests of the movement that road damage should be minimised, and the character of the service at present being rendered by military lorries certainly tends towards the use of vehicles with larger wheels and bigger clearance. The worse the road conditions, the more necessary does the large wheel become. If the war tends to accelerate the general adoption of bigger wheels and higher ground clearance, it will simplify the problem of filling the demands both of the home and of the oversea markets. It will also tend towards lower operating costs, since wheel diameter is an important factor in the protection of the chassis from shock due to road inequalities.

Another beneficial influence which we may fairly anticipate is the encouragement to fit some form of wire rope gear, preferably operated by engine power. Even a hand-operated gear would often be very useful, and there are many classes of service, as, for example, the carriage of road materials from quarries and of agricultural produce from farms, in which the presence of an efficient gear of some kind would often eliminate serious troubles and delays. Yet another point to which we may expect attention to be drawn is the provision on the heavier classes of petrol vehicles of some simple means of temporarily locking the differential. A fitment of this kind is quite usual on steam lorries and tractors. It can be simple and quite cheap, and it is not only in military service that it would often be found useful.

Although the war has not led to any petrol shortage, it has at least drawn attention to the importance of the provision of fuel supplies within the Empire. Mr. E. H. Cunningham Craig, in a recent paper before the Institution of Petroleum Technologists, dealt with the possibilities of the prospective oil fields in Western Canada. The most striking find in that quarter up to date has, of course, been the discovery of an extraordinarily light crude oil at the Dingman well near Calgary. This oil contains over 70 per cent. of motor spirit and about 20 per cent. of kerosene. Mr. Cunningham Craig, in common with other motorists in the district, has used the crude oil as it came from the well in the tank of his car. He found that his engine ran perfectly satisfactorily, and even developed better power and hill-climbing abilities than it had shown with petrol. The Dingman oil is presumably the result of some natural process of distillation and filtering, and is commonly taken to indicate the presence in the vicinity of larger supplies of heavier oil.

A little time ago Professor Cadman, who read a paper on the oil fields of Trinidad before the same Institution, expressed the opinion that that island was likely to be an important source of motor fuel supplies in the future. As regards the possibilities of fuels other than those derived from petroleum, it was recently stated that the work of the Alcohol Motor Fuel Committee had been unavoidably held up owing to the war, which had not only caused difficulties in connection with the raising of funds, but had also claimed the services of most of the committee's scientific experts. There is, however, a great deal of work to be done in collecting statistics and information relating to the possibilities of growing cheap alcohol crops, and the means of distilling commercial alcohol and of denaturing it. It would certainly seem possible to continue work of this class, even during the war, without encroaching very much on the funds of the committee. Such investigations would certainly lead to the collection of useful data, which should strengthen the appeal of the committee for funds when complete scientific investigation again becomes possible. Consequently, we shall hope to hear that the work of the committee will only be left partially, and not wholly, in abeyance. It should be remembered that after the war there will be an immense amount of wastage to be made good in all directions; and that economy will be more imperative than ever. It is, therefore, desirable that the question of obtaining cheaper fuel should be studied diligently at the present time, so that the ground may be prepared for a real advance as soon as the experts are free once more to undertake fresh experiments.

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MOTOR TRAFFIC.

MAGNETO IGNITION.*

By J. F. Henderson, B.Sc., A.I.E.E.

The magneto is probably about the most perfect part of a modern motor car, in that it gives so little trouble, that the average motorist is inclined to forget its existence, and the average manufacturer and agent treats it very much as a horn or any other accessory which he simply buys and fits on, and is quite content so long as it works, and he does not worry much why or how it does work. The object of this paper is rather to explain the various electrical phenomena concerned, and the steps by which the magneto converts mechanical energy into electrical energy, than to discuss the various types of magnetos at present used. The author will first of all explain shortly the elementary principles of the electric current, as some here may not be quite familiar with these, though he is assuming that all here know the mechanical details of a modern magneto.

The electric current may be compared to a stream of water, and although the analogy is not rigorously true, it is good enough for our present purpose. The quantity of electricity is measured in coulombs, say corresponding to gallons of water. The current is measured in coulombs per second, corresponding to gallons per second. The unit, one coulomb per second, is called an ampere, so that the ampere is the rate of flow, corresponding to gallons per second. Electrical resistance corresponds to the resistance of pipes, etc., to the flow of water. The usual electrical unit of resistance is the ohm and is more or less reciprocal to the size of pipe in the water analogy. The voltage or difference of potential (E.M.F.) measures the electrical pressure, which corresponds to lb. per square in. or feet of head water pressure. And, just as when the water pressure or head is increased, more water per second will pass through a given pipe, so, by increasing the voltage, more electricity flows per second through a given wire; conversely, if the size of the pipe is increased and the pressure kept constant more water passes; in the same way, if the resistance of the wire is reduced, more electricity passes. In all cases of a steady, continuous electrical flow, the current voltage and resistance are connected together by the relation

$$C = E/R \quad \text{..... ..... (i)}$$

from which, when any two of the three quantities are known, the the third may be calculated. The author has found that a lot of people seem to think that nothing but 20 volts can be obtained from a 20-volt battery.

Fig. 1 shows a 20-volt battery connected up with a number of lamps of voltages varying from one up to five, so arranged that they would all be properly lighted. It will be noticed that the total current through any part of the circuit is, in each case, three amperes. To make clearer the relation between amperes and volts, if we consider a large river like

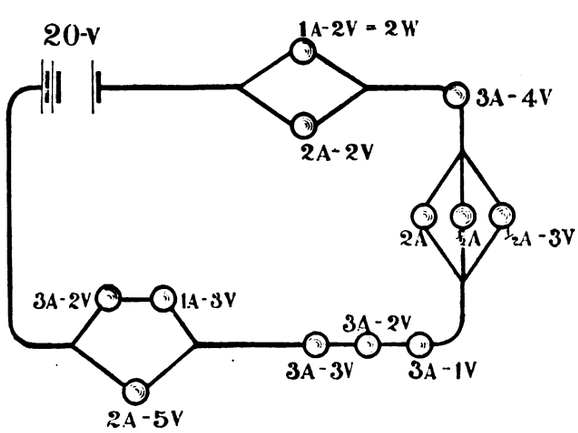

Fig. 1.

the Clyde, it would have a large number of amperes and a very low voltage, whereas, if we take a small stream tumbling down a hill side, it would have very few amperes but a high voltage.

Now let us see what a magneto is required to do. The object is to design the smallest and lightest machine which will produce a sufficiently energetic spark at a definite moment, and if it is realised that the engine may be running at 3,000 revolutions per minute or 1/50th of a second per revolution, and that the difference between the fully advanced and fully retarded position of the spark is only about 30 degrees or 1/12th of a revolution, it will be seen that the time of the spark is only altered by 1/600th of a second altogether, so that the time factor in the problem is very important; luckily, however, electricity is rather quick in its movements, although, as will be shown later, special precautions will have to be taken to take complete advantage of this feature. It may be of interest to mention that when the ignition lever is moved, seconds are being divided into thousandths or even into ten-thousandths.

There are three ways in which the required current may be produced. First by means of a battery, which used to be the most common way, but which has now practically gone out of use, although many people are inclined to think that since a supply of electricity is available in the battery of the lighting set on so many cars it will again become more general. The author is not, however, inclined to agree with this, as though the magneto is an additional piece of apparatus, it does its work more satisfactorily than an ignition coil supplied with current from the lighting battery. The reason that the trembler or make and break of a battery system gives more trouble than that of a high-tension magneto is that the quantity of current is very much greater. This cannot be avoided, seeing that the primary of the magneto gives a very much higher voltage than it would be practicable to use for lighting.

The next method of producing current is by means of a dynamo. A dynamo is similar to a magneto except that it has electro magnets instead of permanent magnets. Now, as the current used in a magneto is alternating, it is not suitable for magnetising electro magnets, and, therefore, either a battery or an additional generator would be necessary to energise the electro magnets, which makes a dynamo altogether unsuitable. The magneto, therefore, is by far the best means of producing the current.

Now, in order to produce a spark, one of two things must be done; either a circuit in which a current is already flowing must be broken, or such a high voltage must be produced that it is sufficient to make an appreciable quantity of electricity jump across a small air gap inside the cylinders and so produce a spark. The first of these is what is used in a low-tension ignition system; the second, which is now almost universal, is what is used in a high-tension system. The low-tension magneto is the simpler, and also forms a part of a high-tension magneto. The author will, therefore, consider it first.

In 1831 Faraday discovered that if a conductor is moved in the field of a magnet a difference of potential is produced between its ends, and that if they are connected a current will flow in the conductor. Now the field of a magnet is usually represented by lines running from one pole to the other, and the strength of the field is represented by the number of these lines per square centimetre. The electro-magnetic unit of potential is the difference of potential produced in a wire which cuts one line of force per second. One volt equals 100 millions electro-magnetic units. Therefore E, the voltage produced in an armature, equals the number of conductors multiplied by the number of lines cut per second divided by 10^8 volts. Now, in a simple H armature as used in most magnetos, each wire cuts the field twice in every revolution and in alternate directions, and, therefore, an alternating voltage is produced, the current flowing, or trying to flow, first in one direction and then in the other. In a continuous-current dynamo the same thing happens, but a commutator is fitted and is so arranged that the current, in the outside circuit, is always in the same direction.

Fig. 2 shows the various positions of the armature and the flow of magnetic lines from the one pole to the other through the armature. As the armature moves from the position B to the position C it will be seen that all the wires in the armature have cut the lines of force of the field in one direction, and at E the lines have begun to pass through the armature in the opposite direction, and at F are entirely reversed. Near the position C, the number of lines being cut by the wires is a maximum, and therefore the highest voltage is obtained about this point, as shown at the point Z on the curve below. As the armature revolves through the next half revolution the wires cut the lines in the opposite direction and so produce a voltage in the opposite direction, which will have a maximum at Z_1. When a current is passing through the armature it is obvious that it becomes itself an electric magnet which reacts on the magnetism of the field. This has the effect of twisting the magnetic field in the pole pieces somewhat as is shown at B, D, and E. This makes the point of maximum voltage somewhat later than it would be if there were no armature reaction.

As is well known, the armature core is built up of stampings: the reason for this is that if it were solid iron it would act like a coil revolving in the field, and currents would be generated in it. These eddy currents are useless, and only heat up the armature and interfere with its proper action.

* A paper read before the Institution of Automobile Engineers on February 10.

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MOTOR TRAFFIC.

Magnetic Field.—To produce a magnetic field of force a magnet of some sort is required. If a coil of wire is taken and a bar of iron, say of horseshoe form, put through it, an electro magnet results. Various materials vary very much in their conductivity of magnetic lines. The property of conductivity for magnetic lines is called the permeability of the material, and is unity for air or any non-magnetic material. The reciprocal of the permeability or the resistance to lines of force is called the reluctance of the magnetic circuit.

If a current is now passed through the coil a magnetic field will be produced between the poles, proportional to the number of ampere turns, that is, ampere of current multiplied by the turns of wire in the coil, divided by the total reluctance of the magnetic circuit. If a soft iron armature is placed across the poles, the reluctance will be very

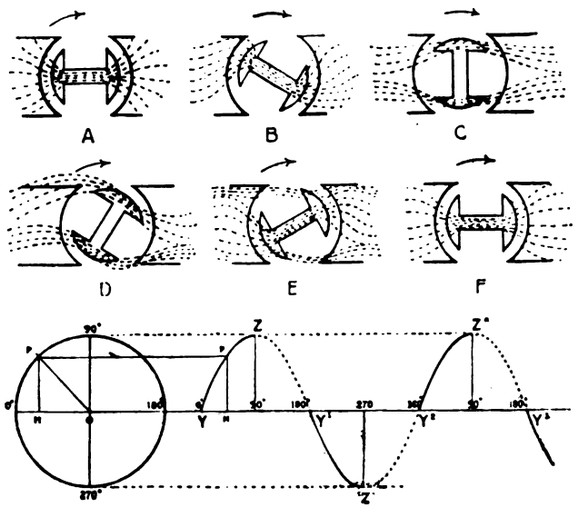

Fig. 2.

much reduced, and the number of lines passing from one pole to the other will be very much increased, and when it is remembered that the permeability of soft iron is from 300 to 3,000 times that of air, the importance of keeping the air gap between the poles and the armature as small as possible will be realised. Fig. 3 shows the permeability of various materials at various flux densities: H is the magnetic force; B is flux density, and it will be seen that the curve for soft iron rises very rapidly and then gets nearly flat, so that the sectional area of the magnetic circuit must be made large enough to keep the intensity of the magnetic field down to a reasonable figure, otherwise an exorbitant magnetising force will be required. $B/H = \mu$ the permeability.

Fig. 4 shows the magnetisation of a piece of iron, first in one direction and then in the other. Starting from zero, if a magnetising force is applied, the magnetisation rises to a point A. If, now, the magnetising force is reduced to zero, the core will remain partly magnetised, to a degree represented by the amount OB, and the force will have to be of a considerable strength in the opposite direction before the magnetisation becomes zero. If the force is still further increased in the opposite direction, the magnetisation will rise to a point D in the opposite direction. If this current is reduced and reversed again, the same thing will happen, and a certain amount of work has been done in reversing the direction of magnetism in the core. This amount of work is represented by the area of the diagrams A, B, C, D, and E, and is known as the loss due to hysteresis of the iron. The softer the iron, the less will be the loss. The hysteresis also causes a certain period of time to elapse after the force is reversed until the field attains its maximum strength in the opposite direction. The more rapidly the field is reversed, the greater will be the work wasted by hysteresis.

Now, if a permanent magnet is used instead of an electro magnet, a magnetic field is produced in exactly the same way except for this important difference, that there is now a permanent magneto motive force, and the maximum number of lines which can get through the circuit are the number of lines which are already passing through the middle section of the magnet, so that a permanent magnet is very similar to an electro magnet with a saturated core. The magnets themselves are made of particular alloys of steel, usually containing tungsten, and are a special branch of manufacture by themselves. The hardening is a process which requires great knowledge and care; magnets are always very hard, but not necessarily glass hard. For instance, if a long and short magnet are made of the same steel, the short magnet must be made rather harder than the long one to get the best results out of each. The two qualities required in a magnet are high magnetisation and permanence. The great bulk of magnets made are for scientific instruments, and are usually very small in size. These

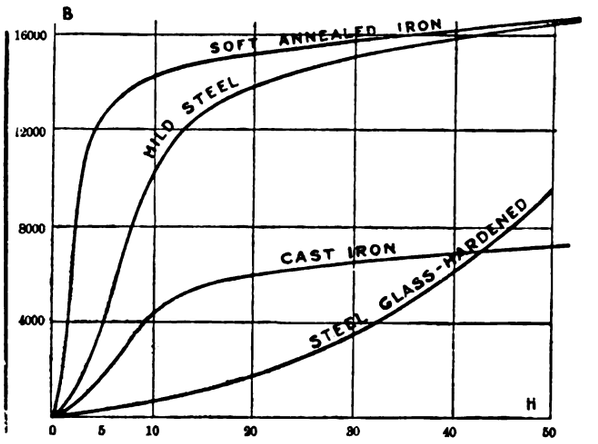

Fig. 3.

require to have as nearly absolute permanency as can be obtained, and do not necessarily require to be very strong, whereas the magnets for a magneto are large, and, therefore, much more difficult to harden uniformly, while they must be as powerful as possible and must be reasonably permanent, so that even a different steel may be found to be better for them. Magnets will never remain permanently as strong as they are when they are newly magnetised, and consequently the practice of the author's firm is to lay the magnets aside in a rack for a fortnight before they are tested, and it is found that by that time they have come down to a sufficiently permanent state. A good magnet should give about 200 lines per cubic centimetre. Thus, a magnet 32·4 cm. by 4·5 cm. by 1 cm. gives a total flux of 3,000 lines.

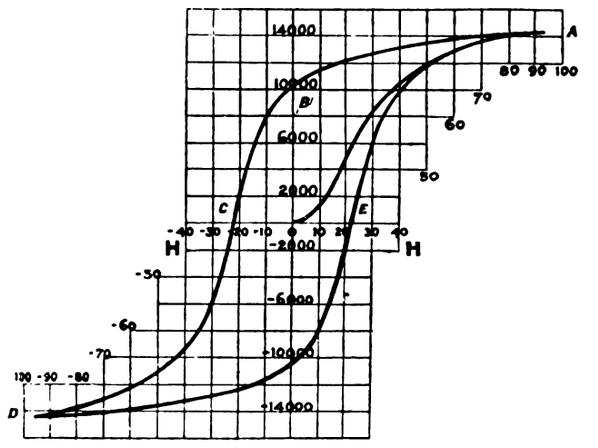

Fig. 4.

It has already been shown that by revolving the armature of a magneto an alternating voltage is produced, and this results in rather more complicated conditions than with continuous currents. When a circuit is completed, the current does not rise at once to its full strength, nor does it fall instantly to zero when the circuit is broken. This is due to a property of the circuit called self-induction. A coil of wire carrying a current produces magnetic lines of force; when the current is broken these lines collapse, and in collapsing cut through the wires of the coil and produce a voltage in addition to the original voltage between the ends of the coil, proportional to the number of wires cut multiplied by the total number of lines which cut them per second. As has already been seen, if a soft iron core is now placed inside the coil the number of lines will be increased 300 to 3,000 times, and, therefore, the induced voltage will also be increased in proportion, and when the circuit is completed a voltage will be produced, but this time in the opposite direction to the original voltage. This property is known as the self-inductance of the circuit. The practical unit of self-inductance is called a "henry," and is the self-inductance of a circuit

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in which a change of current of one ampere per second produces one volt.

A rapid fall of current has now to be considered, such as takes place when the circuit is broken. If C is the current flowing in the circuit, then dc/dt represents the time rate of change of current, and if the total electromotive force due to self-induction is e, then

$$e = E - L(dC/dt) \quad \text{.....(ii)}$$

when L is the coefficient of self-induction. But when the strength of the current is falling dC/dt is negative, and therefore the resulting electromotive force is positive, and so tends to maintain the current, but by Eq. (i) $e = R_1C$

Hence, on substituting in (ii), we have

$$R_1C = E - L(dc/dt) \quad \text{.....(iii)}$$

the solution of which, as may be verified by differentiation, is:

$$e = E\{1 - \epsilon^{-(R_1/L)t}\} + \{E(R_1 R)\epsilon^{-(R_1/L)t}\} \quad \text{....(iv)}$$

If t is very small, $\epsilon^{-(R_1/L)t}$ becomes practically unity even if R_1 is large. Therefore, for an instant after the resistance has been suddenly raised from R to R_1 the voltage becomes approximately

$$e = E(R_1/R) \quad \text{.....(v)}$$

and therefore may be many times as great as the primary voltage E, when the circuit is broken. Theoretically, a current takes infinite time to rise to its full value E/R or to fall to zero.

Self-induction corresponds to inertia in the water analogy. If, for example, in a pipe with two outlets, one having a cork in it and the other a cock, the cock is suddenly closed, the cork will be forced out by the inertia of the water. Or, in a model as shown in Fig. 5D, where a rod is fixed to a flywheel I, if a force is applied to the top of the rod tending to revolve it in the direction shown by the arrow, it will take an appreciable time to gain velocity, and when the force ceases, the flywheel will tend to continue in motion exactly as does electricity in a circuit with self-induction when the E.M.F. is applied and removed.

There is another property, called capacity, which exactly corresponds to capacity in the water analogy. For instance, if the water is turned on at one end of an empty pipe having considerable capacity, there will be a period of time before the water begins to come out at the

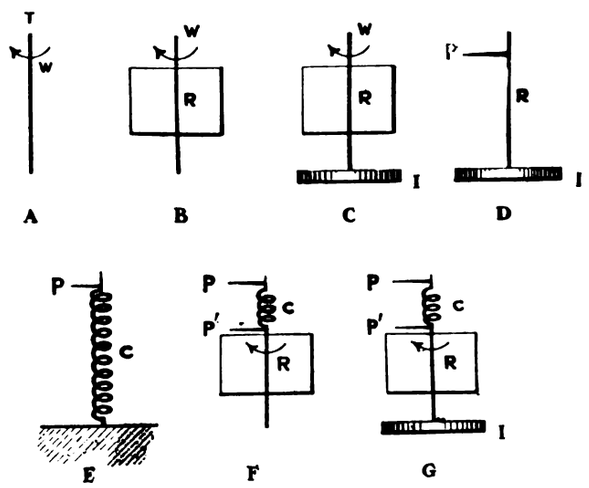

Fig. 5.

other end. In the same way, if a voltage is applied to an electric circuit having capacity, it will take time before the current rises. Self-inductance and capacity in a circuit always tend to neutralise one another. This can be shown by taking a pipe, this time with three nozzles, a cork in one, a cock on the other, and a football bladder on the third. It was shown that when there was self-inductance alone the cork was blown out as soon as the cock was suddenly turned off, but in this case, when the cock is turned off, the water will simply rush into the bladder and expand it instead of forcing out the cork, and when the inertia is expended, the bladder will contract and force some of the water back through the pipe. This is exactly what happens in the case of the condenser fixed across the make and break of a magneto. Looking at Fig. 5E, a spring will be seen attached to the table. If the top is now revolved as before there is no movement at the bottom, but, as soon as the top is released, it simply revolves back again. This represents capacity. The unit of capacity is called a "farad."

Fig. 5A. If W is supposed to be a wire having no inertia, and a twisting force is applied to it, it will resist the force in no way. This represents an electric circuit with neither resistance, induction nor capacity.

Fig. 5B. If a paper vane, supposed to have no inertia, is placed on the wire, the air resistance of this, as the wire is revolved, exactly corresponds to resistance in an electric circuit. As has already been seen, Fig. 5D represents self-induction; Fig. 5C represents a circuit having both resistance and self-induction, and Fig. 5E represents capacity. Fig 5F represents a circuit having resistance and capacity only, and if the pointer P is revolved with a constant force it will revolve with a constant speed, but the spring C will be twisted through

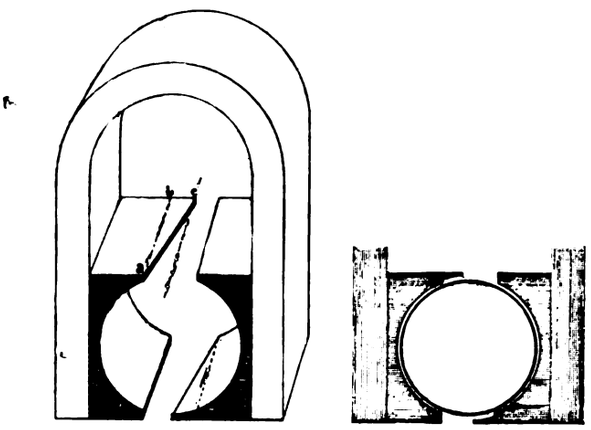

Fig. 6.

a certain definite angle; on starting up, however, P_1 will lag somewhat behind P; this is due to the capacity.

Fig. 5G. If a force is applied to the pointer P, the first thing to happen will be that the spring will coil up somewhat, then the energy stored in C will gradually start up the flywheel I, and when P is stopped the flywheel I will continue to revolve and when it comes to rest the spring will be coiled somewhat in the opposite direction, and the flywheel will swing back in the opposite direction and gradually come to rest. If R is large, this motion will be damped and the flywheel will come to rest in one swing without oscillating past the zero position. This represents a circuit having capacity, resistance, and self-induction.

Looking again at Fig. 2, as the armature rotates from the position A to the position B, the voltage is increasing, and becomes a maximum somewhere about the point C. This is represented in the curve below at Z, about which point the circuit is broken by the contact breaker.

There is an interesting point here which was pointed out by the author's co-director, Mr. Blackwood Murray, about 1899, and that is, that as the armature is moving from the position C through D and E to the position F, the field in the armature, due to the current generated, is in the opposite direction to the field of the magnets, and, therefore, tends to weaken them. But the current which is to be made use of is in the opposite direction, so that if the circuit is closed between Z and Y a current is generated which has got to be reversed before commencing to generate a current in the required direction. Mr. Murray, therefore, kept the circuit open until the point Y was reached, the importance of which will be shown later.

It may be noticed here, however, that with this arrangement there is no time at which the magnetism of the armature is opposing that in the magnets, and that, when the current is flowing, it is always magnetising the armature in the same direction as the magnets. As a result of this, the magnets are always tending to become stronger, and the author has actually found that a magnet which would lift 16 lb. when it was put into a magneto, lifted 17 lb. after the magneto had been running for a year. The effect is probably not usually so marked as this, but it should at least make it certain that the magnets should never require to be remagnetised, which is practically found to be the case.

In Fig. 7, the upper diagram shows the old type of Bosch contact breaker which was used up to the last year or two. The lower one shows the type which that firm now uses. In the upper diagram C and C are rollers, and it will be noticed that as the contact breaker revolves, the current is only broken for a very short period. In the lower diagram, the contact breaker is operated by means of two long segments, C_1, which keep it open for about 90 degrees, or from the

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points Z to Y_1 in Fig. 2, and, therefore, the effect described above is obtained.

The distortion of the field due to the armature reaction has already been mentioned. A few years ago, Mr. Murray discovered that if the trailing tip of the pole piece were made bevelled instead of parallel to

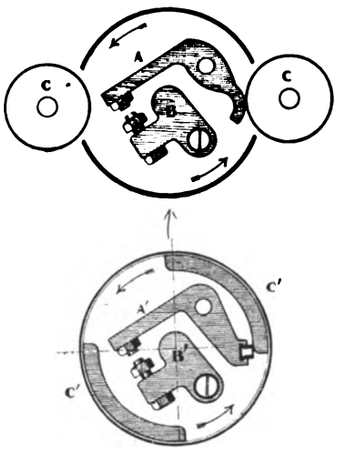

Fig. 7.

the axis of the armature, as shown by the line a, c, Fig. 6A, it had the effect of apparently making the field rotate against, instead of with, the direction of the rotation of the armature, so making the point of maximum current earlier instead of later as the speed of the armature increased. The reason of this is not very clear, but it may, perhaps, be explained as follows: When the armature is revolving slowly the lines have time to collect themselves at the point C, and are, therefore, not cut until this point is reached, whereas, as the speed gets greater, they have not time to crowd together in this way, and are, therefore, cut as soon as the edge of the armature begins to pass the edge of the pole piece. In the Bosch magnetos this result has been attained by using a pole piece of the shape shown in Fig. 6B. Their first arrangement was to make the edge of this pole piece with projecting teeth.

As is well known, it is necessary to advance the ignition lever as the speed of the engine increases. The reason for this is partly electric, but mainly mechanical; there is a lapse of time between the moment at which the points of the contact breaker are drawn apart and the moment at which the pressure in the cylinders attains its maximum. In a low-tension ignition arrangement, after the ignition rod leaves the cam there is a small interval of time before the spark is made, which may be about 1/400th of a second, then the burning of the gas in the cylinders takes anything from 1/100th to 1/500th of a second to be completed. Suppose the total time is a 1/200th of a second, it is quite obvious that this will represent a much greater angle on the flywheel when the engine is running at 2,000 revolutions per minute than it will if it is running at 200 revolutions per minute, in fact, just 10 times as great.

Though the lag of the ignition gear is very small, it is quite a simple matter to measure it. If an insulated disk with a metallic contact let into it at one point and connected to earth is fixed on the crank shaft, and if a brush connected to the ignition plug is pressed against this disk, it will be obvious that if it is placed in any such position that the brush meets the earth contact on the disk before the break is made there will be no spark. If, however, the brush is moved forward so that it does not meet the earthed contact until after the break in the ignition gear is made, a spark will be obtained. If the engine is now revolved faster, the brush will come into contact with the earthed contact before there has been time for the spark in the ignition plug to be made, and if the throttle is opened full up, it will be found that the speed of the engine will not increase beyond a certain point, and that it will commence to miss at this point. It is then a simple matter to calculate the time between the ignition gear beginning to move and the time at which the brush comes into contact with the earthed contact piece, which is the time taken for the spark to occur after the contact is broken.

In order to follow what happens in an armature, the effect of self-induction in the circuit must be more fully considered.

If a voltage E is applied to the armature, the rate building-up of the current in the circuit is given by the equation

$$E = CR + L(dc/dt) \ldots\ldots\ldots\ldots \text{(vi)}$$

This is a simple differential equation of the first order.

Dividing through by R and rearranging

$$(E/R) - C = (L/R)(dc/dt).$$

But from Eq. (i) $E/R = C$, and if T is written for L/R, then

$$C - c = T(dc/dt)$$

$$\therefore\ dt/T = dc/(C - c)$$

Integrating

$$t/T = \int dc/(C - c)$$

$$= -\log (C - c) + A \ldots\ldots\ldots \text{(vii)}$$

To find the value of A, put $t = 0$, then $c = 0$. Substituting these values in Eq. (vii)

$$A = \log C,$$

$$\therefore\ t/T = \log C/(C - c),$$

or, changing to the exponential form,

$$(C - c)/C = \epsilon^{-t/T}$$

$$\therefore\quad c = C(1 - \epsilon^{-t/T})$$

or

$$c = E/R\{1 - \epsilon^{-(R/L)t}\}$$

This is the same as C given by Ohm's law multiplied by a factor

$$(1 - \epsilon^{-(R/L)t})$$

L/R is called the "time factor" of the circuit, and is denoted by T. The current builds up to 0·6343 E/R in time L/R. Table I.

TABLE I.

t/T.	C.	t/T.	C.
0	0 E		E
0·1	0·095 R	2·0	0·8646 R
0·2	0·181 ,,	3·0	0·9501 ,,
0·5	0·3936 ,,	6·0	0·9975 ,,
1·0	0·6343 ,,	12·0	0·9999 ,,

gives various values of C at times t/T. Theoretically, the current never reaches the value E/R. An example will show the effect of this more clearly. When $t/T = 3$, from the table the current = 0·95 E/R. If E is increased to 10 E and t/T is taken = 1/10, from Table I., the current = 0·095 × 10 E/R = 0·95 E/R, so that with the higher voltage the current has built up to the same value in 1/30th of the time. But the magneto has to run at only ten times its previous speed to give ten times the voltage, therefore, it will only have to turn through one-third of the angle in this particular case before it builds up to the same current, or, in the same angle, it will produce nearly twice the current. The spark is, however, wanted earlier at high speeds, and if it were not for the fact that the lag of the current gets less at high speed, there would always be a weaker spark as the speed increases. This is a very important result, and it is this which really makes high-speed magnetos possible. When the current is broken it falls very much more rapidly than it rises when the circuit is complete. The reason for this is that although it falls by the same law as that by which it rises, seen above the time taken depends on the value of L/R. Now, when the circuit is broken, R becomes almost infinite, and so the time constant becomes very small, and as the current will have practically come to zero in seven times the time constant, it will be seen that even this is a very small period of time.

The simplest way to study the effect of the self-inductance in a magneto is graphically. If a sine curve O, A, Fig. 8, representing the voltage at each point necessary to produce the required current

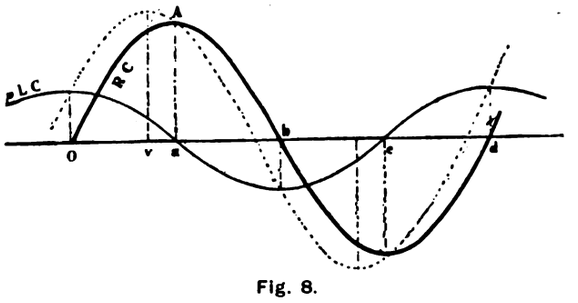

Fig. 8.

against resistance only, is plotted, it will also represent to a different scale the current, since E = RC. Now, the reacting voltage = $2\pi n$LC (virtual) volts, and can be shown to be half a period out of phase with the curve RC. These two curves added together give the dotted curve V. This is the voltage necessary to produce the required

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current against resistance and self-inductance. A sine curve is taken for these diagrams as it is the simplest, but it is not absolutely correct for any practical alternator, though approximately so. Now this diagram is not applicable to a magneto, since it is for an alternator in which the circuit is continually closed. In a magneto, as seen above, the circuit is only closed for a short period and then opens for a further period.

Fig. 9 shows the same curves with others added. V_2 is a curve for a voltage double that shown in V. The current produced is shown by the curve RC_2, and the self-induction by the curve $-pLC_2$. These curves have been worked out backwards in order to get V_2 = twice V. It will be noticed that the curve RC starts from a point A_1, whereas RC_2 starts from a point A_2 some 25 degrees later. These two curves, however, cross at a point B, so that above this point the lag of RC_2 is

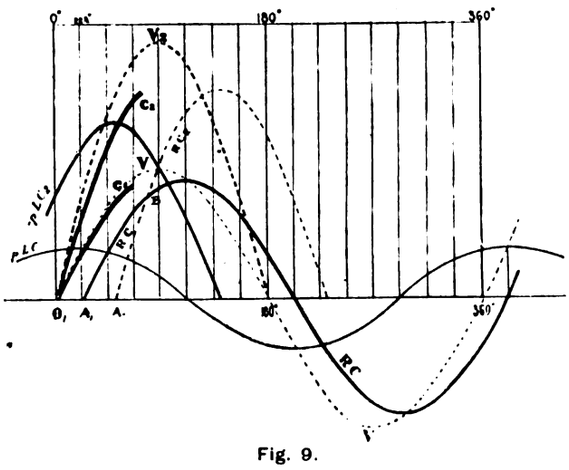

Fig. 9.

less than that of RC. Now these two curves are not yet what is required, as they are for a circuit which is continually closed. By keeping the circuit open until the point O_1 is reached, it is obvious that the current in both cases will start to build up from this point. If, therefore, the two curves RC and RC_2 are shifted back to the point O_1 the curves C_1 and C_2 are obtained. These are, however, higher than what would actually be obtained, as they are what would be produced by a voltage curve moved still further back. The actual curves, therefore, will start from O_1 and be somewhere between the curve C_1 and RC and the curve C_2 and RC_2, and as they will be of the same form, the curve corresponding to C_2 will always run above the curve corresponding to C_1, which means that as the two diagrams are plotted on a scale of degrees of rotation of the armature, the angle of lag in the second case will always be less than the angle of lag in the first case, which shows that the faster the magneto runs the less will be the angle of lag due to this cause.

Now that the working of a complete low tension magneto ignition system has been considered, the high-tension magneto may be looked into. The high-tension magneto consists essentially of a low-tension magneto and an induction coil. Mutual induction is a phenomenon similar to self-induction, which has already been considered. If two coils of wire are placed side by side, with a current passing through one of them, and the other is connected to a galvanometer, and the current in the first coil is varied, an E.M.F. will be induced in the second coil, depending on the mutual inductance and number of turns of the coils, and this effect will be very much increased if the coils are on an iron core, as was the case with self-induction. If one coil consists of a few turns of thick wire and the other of a large number of turns of thin wire wound on the same core, and a current passing through the thick wire coil, when the circuit of the thick wire is broken very high voltage will be produced in the thin wire coil. The thick wire coil is usually called the "primary" and the thin wire coil is called the "secondary." These are usually now wound together on the armature of the magneto; this has the advantage that the core does duty for the armature of the magneto and the core of the induction coil. There will also be a voltage produced in the secondary, due to its rotating in the magnetic field. This is, however, not very great in proportion to the final voltage produced, but in any case it is in the same direction.

The author will now indicate what happens when this very high voltage which is produced becomes great enough to make a spark at the ignition plug. The nature of this spark depends on the self-inducton, capacity and resistance of the secondary circuit.

If K = capacity of the circuit.
Q = quantity of electricity discharged.
L = self-induction of the circuit.
R = resistance of the circuit.
E = E.M.F.

Then

$$Q = KE \quad \text{.....(viii)}$$

$$C = dQ/dt \quad \text{.....(ix)}$$

and rate of dissipation of energy =

$$-(d/dt)(\tfrac{1}{2}QE) = C^2R + (d/dt)(\tfrac{1}{2}LC^2) \quad \text{....(x)}$$

or

$$-(d/dt)(\tfrac{1}{2}Q^2/K) = C^2R + LC(dc/dt)$$

$$\therefore \; -Q/K.\, dQ/dt = (dQ/dt)^2R + L\, dQ/dt.\, d^2Q/dt^2$$

$$\therefore \; d^2Q/dt^2 + R/L.\, dQ/dt + Q/LK = 0 \quad \text{.....(xi)}$$

This is a differential equation of the second order, and may be solved by means of a subsidiary equation. The subsidiary equation is

$$m^2 + (R/L)m + 1/LK = 0$$

from which

$$m = -R/2L \pm \sqrt{(R^2/4L^2) - (1/LK)}$$

Hence the roots are real if

$$R^2/4L^2 > 1/LK, \textit{ i.e.}, \text{ if } R^2 > 4L/K.$$

When the roots are real the solution is

$$Q = Q_0/(x_1 - x_2)\{x_1\epsilon^{x_2t} - x_2\epsilon^{x_1t}\} \quad \text{.....(xii)}$$

$$\therefore \; C = -dQ/dt = \{Q_0x_1x_2/(x_1 - x_2)\}\{\epsilon^{x_1t} - \epsilon^{x}\} \quad \text{..(xiii)}$$

where x_1 and x_2 are the roots found from the subsidiary equation. This indicates unidirectional flow.

But if $R^2/4L^2 < 1/LK$, *i.e.*, if $R^2 < 4L/K$, x_1 and x_2 are imaginary, and in this case the solution is known to be

$$Q = Q_0\epsilon^{-nt}\{\cos n^1t + (n/n^1)\sin n^1t\} \quad \text{.....(xiv)}$$

$$\therefore \; C = -dQ/dt = (Q_0\epsilon^{-nt}/LKn^1)\sin n^1t \quad \text{.....(xv)}$$

where $n = R/2L$ and $n^1 = \sqrt{(1/LK) - (R^2/4L^2)}$.

This indicates oscillatory flow.

The complete period of the oscillations will be

$$T = 2\pi/n^1 = 2\pi/\sqrt{(1/LK) - (R^2/4L^2)} = 2\pi LK/\sqrt{(LK - \tfrac{1}{4}R^2K^2)} \quad \text{..(xvi)}$$

or if R is small it will be approximately

$$T = 2\sqrt{LK} \quad \text{.....(xvii)}$$

The oscillations will die away as shown by the full line in Fig. 10.

From this it will follow that in order to produce an oscillating discharge R and K must be kept low in proportion to L.

Now, the work done in the discharge

$$W = \tfrac{1}{2}EQ = \tfrac{1}{2}E^2K \quad \text{.....(xviii)}$$

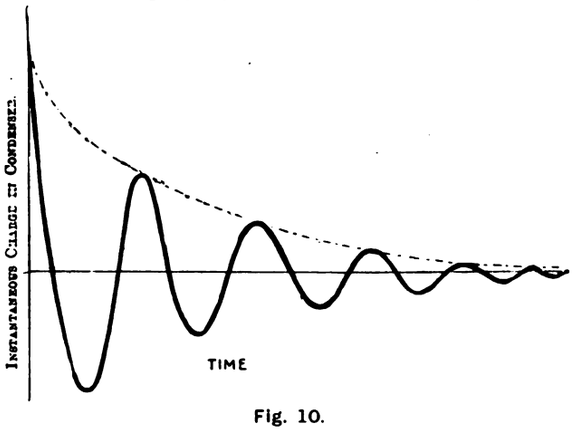

Fig. 10.

or, dividing by J (4·18 joules) the quantity of heat generated is given.

The shorter the time in which this is discharged the higher will be the temperature

In a circuit without self-induction, the relation between Q and t is arrived at by the equation

$$Q = Q_0\epsilon^{-t/RK} \quad \text{.....(xix)}$$

from which it can be seen that in time RK, Q falls to 0·3679 of its original value and is a steady discharge.

In an oscillatory discharge the quantity of electricity in successive waves is represented by

$$Q = Q_0\epsilon^{-\pi/\sqrt{(4L/RK) - 1}} \quad \text{.....(xx)}$$

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from which it can be seen that the greater R^2K/L, the more rapidly will the wave die out, so that in this case R and K must be kept small to give the greatest number of oscillations, but K must be kept as large as possible in order to get as much heat generated as possible, and so R must be kept small and L large to get the quickest possible discharge. The rapidity of the discharge may not be of much importance unless the lag is very great, as the time is so short in any case that there may not be time for an appreciable quantity of heat to get away before the discharge is completed.

The self-induction will at first slow the discharge, and as the discharge begins to die out will accelerate it.

From the above it will be seen that the smaller R and K are the more quickly will the discharge take place.

If a certain discharge is sent through a fine wire, neglecting the loss of heat, the temperature will be inversely proportional to the mass of the wire, since a definite quantity of heat is generated.

Now, if the wire is replaced by gas, it is not possible to calculate how much gas is in the path of the spark; it could, however, be determined experimentally.

Oscillatory discharges, especially when the frequency is high, have a curious property in that they will jump a spark gap even when there is considerable leakage between the two sides of it, and so, probably, have an advantage for ignition purposes, as a spark would be produced even though the plugs were so dirty as to cause considerable leakage.

The maximum value of E is what the magneto can produce. The actual value will depend on the length of the spark gap at the ignition plug and the pressure of the gas in the cylinder. It has been found that for a certain length of spark gap the spark will take place at a certain definite voltage, which will be higher as the gap is increased.

Table II. gives the voltages required to produce various lengths of spark between polished metal balls of 1 cm. in diameter. The voltage is considerably affected by the size of the ball, and is less as the size of the balls is diminished. The voltage required to produce a given spark in an ordinary ignition plug will, therefore, be considerably less than is shown by these figures. The author is, however, of opinion that the spark between 1 cm. balls would be a very convenient standard for testing magnetos by. The voltage required to produce a spark in air at different pressures has been found to vary almost exactly as the pressure,* except at very low pressures, *i.e.*, if the pressure is doubled the voltage

TABLE II.—SPARK BETWEEN BALLS 1 CM. IN DIAMETER.

Length of Spark Cm.	Difference of Potentials.	
	Electrostatic Units.	Volts.
0.1	16·1	4,830
0·5	56·3	16,890
1·0	84·7	25,440
1·5	97·8	29,340
2·0	104·5	31,350
3·0	124·0	37,200
5·0	153·0	45,900
10·0	187·8	56,100
15·0	206·0	61,800

required to produce a given spark will be doubled. This produces rather a curious result. With a given ignition plug, the higher the pressure in the cylinder the better the spark will be, provided the magneto is powerful enough to make a spark at all. The reason of this is that the voltage will rise higher before the spark takes place, and as has been seen above, the work done by the spark is as the square of the voltage.

From this it also follows that the points of the ignition plug should be kept as far apart as possible in order to get the best spark. If for any reason the spark gap has to be kept small, the spark can be improved by increasing the capacity of the circuit, and it is just possible that the reason that some sparking plugs work better on some engines than others is that their capacity is either greater or less, and so suits the conditions better.

Some time ago the author's firm was troubled by an unaccountable misfiring on certain engines. It was finally found that if the cables were separated instead of being drawn through a fibre tube the trouble would disappear. The insulation of the cables was tested, but it was found to be quite good. The magneto was then connected to the plug with a long length of the same cable, and it was found that if the middle of the cable was twisted up, missing could be produced, and if it was twisted up still tighter, the engine actually stopped. Later on the same experiment was tried with a larger magneto, but the twisting up the cable then had no effect. It would, therefore, appear that the trouble was caused by the capacity of the cable, as this would naturally be increased by twisting two parts of the cable together.

The actual period of the discharge is probably about 1/10,000th of a second, and if it is oscillating the period may be 1/100,000th, and though the quantity of electricity is very small, the time of oscillation is enormously smaller, and the actual horse-power during this time may reach somewhere about 13 H.P.

There is one part of a high-tension magneto which has not yet been considered—the condenser.

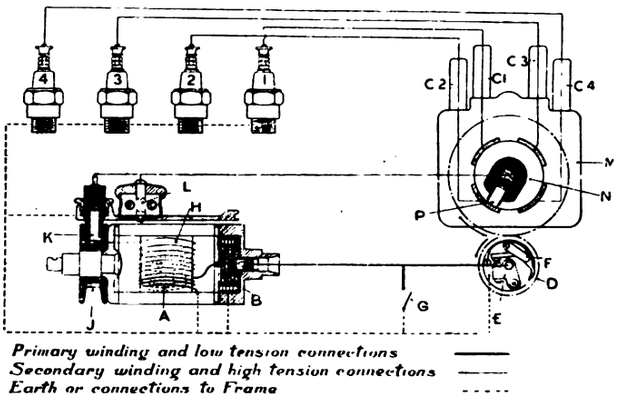

Fig. 11.

Fig. 11 shows the arrangement of a Bosch magneto. The condenser is contained in the end of the armature at B, and consists of layers of tinfoil separated by mica.

Fig. 12 shows the connection more clearly. F shows the condenser, and it will be seen that it is connected in parallel with the points C_3 and C_7, where the current is broken. When the current is broken, if there were no condenser, a large spark would take place between these contacts. When the condenser is connected up, the current rushes into it, and charges it up instead of being wasted in making a spark The condenser then discharges itself, and the

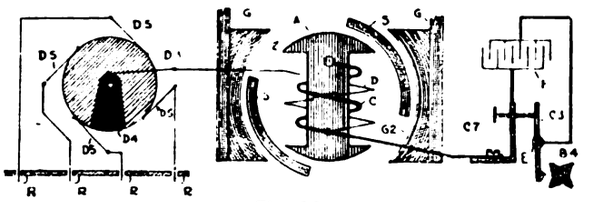

Fig. 12.

electricity produces a current in the opposite direction, round the primary coil, so helping the reverse field. This effect approximately doubles the voltage produced. As will be realised from what has been said above, the capacity of this condenser is most important. The discharge of it is probably oscillatory, but the oscillations should be slow, as it is only the first one which will be of any use. The action of this depends to a certain extent on the rapidity with which the break is made. For instance, Lord Rayleigh found with a particular coil, in which he broke the circuit by means of a rifle bullet, that he got a very much better spark when no condenser was connected than with a condenser. The condenser may also have a certain effect on the secondary spark, though it is not directly connected with it. It will be noticed that in this diagram the secondary of the Bosch magneto is earthed through the primary. This is an unusual arrangement, and in most induction coils it is earthed separately.

Fig. 13 shows this diagrammatically.

A, as arranged on the Bosch magneto;

B, where the coils are separately earthed.

R_1 is the secondary. K is the condenser.

R_2 is the primary. B is the break.

In the Bosch arrangement, when the break is made, the primary and the condenser are in parallel, but are in series with the secondary. Now, in this case, if R_1 is the resistance of the secondary, R_2 the resistance of the primary, and K the capacity of the condenser and L the self-induction of the secondary, if

$$R_1R_2K=L \quad \text{.....(xxi)}$$

then the self-induction of R_1 will be exactly neutralised, so that, whatever the relative values of these, they may have a certain effect on the

* F. Paschen Wied, Ann. 37, p. 69 (1889); W. R. Carr, Proc. Roy. Soc. 71, p. 374 (1903).

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spark which is produced by the secondary, whether advantageous or otherwise the author cannot say, though he thinks the Bosch people claim it to be an advantage. In the arrangement shown at B, R_2 and K are entirely cut off from R_1, and can have no effect on it.

Looking again at Fig. 11, there is still a point which has not been mentioned, *i.e.*, the safety gap L. This is put in as a sort of safety valve to protect the magneto against excessive voltage, and the author would point out that it is never advisable to disconnect a sparking

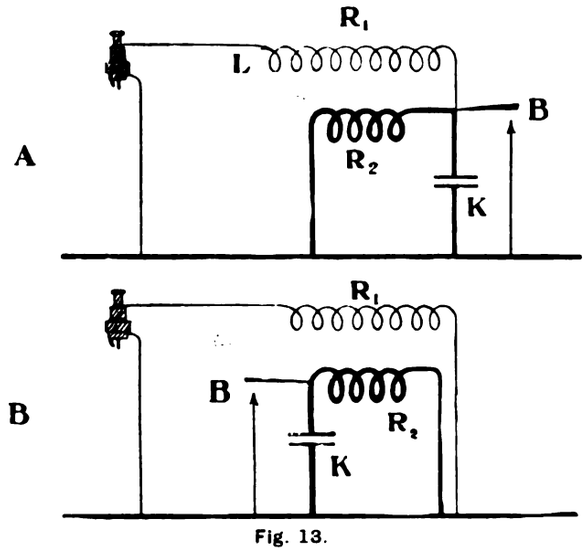

Fig. 13.

plug while the engine is running. It should always be short-circuited. When a plug is disconnected, though L is there to protect the magneto, it is subjecting the insulation of it to a higher voltage than there is any need for, and may in time cause it to break down.

If, now, it is desired to design a magneto, it will be seen that there are a large number of variables. Assuming the magnets to give 120,000 lines, then with an armature core of suitable area there will be a leakage coefficient of, say, 1·3, that is, there will be 120,000/1·3, = 108,000 lines through the armature, and a certain self-induction. If the core is now increased and the magnets are reduced to give the same total induction through the armature, the same voltage would result, but there would be a greater self-induction. This would give a higher voltage when the current is broken, but the lines would build up more slowly in the core, and if the core be increased still further, a point would be reached at which the lines would build up so slowly that there would be no further advantage. Similarly, the more turns put on the primary, the less current will pass through it, and a point will be reached which will give the maximum ampere turns, which is what is required. Similar considerations affect the secondary. The more turns the higher the voltage, but the resistance and capacity are also increased, which would make the passage of the spark slower. It is necessary, therefore, to find the number of turns which will give the maximum spark. All these relations must be fairly nearly right on the best magnetos which are now manufactured, but it is quite probable that they could still be improved.

To those who are thinking of manufacturing magnetos, the author can say that the importance of the patents affecting them is practically *nil*. The most important of the Bosch patents are mentioned in the *Autocar* of August 29, 1914, from which it will be seen that they nearly all apply simply to small details. The question of insulating materials is, however, serious, as most of the best of them come from Germany, though there is no reason why they should not be made in this country.

Since writing the above, the author has had a micrometer made for measuring the length of spark between two balls of 1 cm. in diameter, and finds that a Simms S_4 magneto gives a spark of 1·27 mm., which Table II. shows to require about 6,000 volts. This was with the micrometer connected direct to the magneto, and it was found that at anything above this voltage a spark took place at the safety gap. This means that 6,000 is the voltage available from the lowest up to the highest speeds of the motor. Connecting up to the ignition plugs, it was found that the spark usually took place at from 1,700 to 3,500 volts for various plugs, and these seemed to be about the figures whether the engine was running light or under full load, and are certainly not what would have been expected. From what has been said above about the effect of capacity on the quality of the spark, it seems to the author that a better spark might be produced at high speeds by introducing more capacity into the high-tension circuits. It must be remembered, however, that this would certainly cause missing at low speeds, and would, therefore, have to be arranged so that it could be cut out for low-speed running. This might be found to be an advantage on racing cars.

The author is at present, in conjunction with Mr. J. S. Nicholson, at the Glasgow University, trying to determine by means of an oscillograph the exact forms of the curves indicated on Fig. 9 for a Bosch Z_4 magneto, and, if possible, will communicate the results to the Institution later.

THORNYCROFT VANS FOR THE GREAT WESTERN RAILWAY.

By the courtesy of the editor of the *Great Western Railway Magazine* we are enabled to reproduce a view of a sample of 20 Thornycroft cars, which are now being delivered to the railway company for parcel work. The motor employed is of 24 H.P. Fifteen 30-H P. Maudslay standard passenger cars have also been recently brought into use. These additions to the company's stock have been necessitated by the

Thornycroft Vans—Great Western Railway.

withdrawal of horses for Government purposes. A great deal of work has also been done in conveying troops by road in the railway company's motor vehicles. The company have to a certain extent been fortunate in getting delivery, but a number of other cars are on order which cannot at present be delivered owing to the demands on the manufacturers by the War Office.

No Motor Parade.—The Commercial Motor Users' Association has decided not to promote the usual Whit Monday parade this year; but a correspondence course in technical education has been arranged. The customary championship and other prizes will be awarded to drivers of steam, petrol, and electrical vehicles as the results of written and oral examinations based on this course, together with an inspection of the competitors' vehicles under running conditions. The inspection will be probably held in May.

Electric Accumulators.—Mr. R. J. Mitchell read a paper on "Electric Accumulators" at a meeting of the Association of Engineers-in-Charge. After reviewing the history of storage batteries, Mr. Mitchell described the ideal accumulator as one having light weight, great energy capacity, small volume, great mechanical strength and long life, ability to charge and discharge at high rates, simplicity of upkeep, cheapness of operation, uniform voltage on discharge, immunity from open circuit deterioration or loss of charge. Good as modern lead cells undoubtedly are as compared with what they were, Mr. Mitchell thought it unlikely that they represented the traction accumulator of the future. Many attempts had been made to eliminate lead from storage batteries, and it was 27 years after the coming of the Faure cell that Edison placed his iron-nickel-oxide alkaline accumulator on the market. It was now possible in traction service with one make of battery to count on a life of 15,000 miles as compared with 2,000 or 3,000 miles in the early days. Mr. Mitchell dealt fully with the Edison accumulator, and so much interest was aroused that the Association proposed to arrange for another meeting for discussion of the subject.

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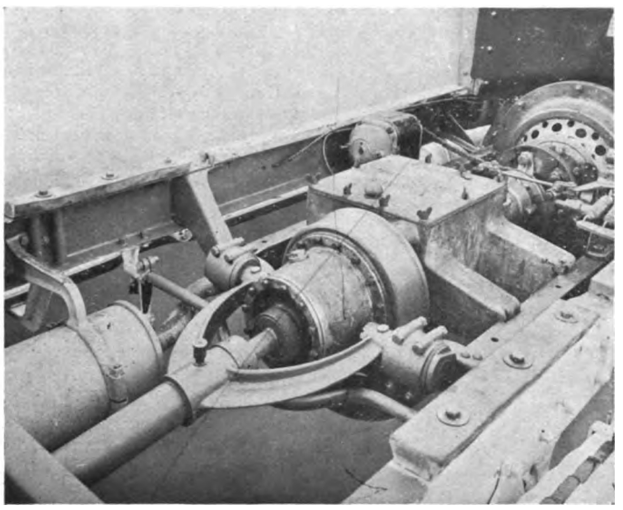
MOTOR TRAFFIC.

NEW DENNIS AMBULANCE FOR THE LONDON COUNTY COUNCIL.

Messrs. Dennis Brothers have recently produced for the London County Council a new type of motor ambulance embodying a number of particularly interesting features. The engine develops 24 H.P. at 900 revolutions per minute, and drives through a large diameter aluminium cone clutch lined with ferodo to the gear box, which gives four speeds and reverse, with direct drive on top speed. Aft of the gear box is a very smooth-acting foot brake of large diameter, of the internal-expanding type operated by cam. The application of the brake is fully compensated, and easy means are provided for adjustment by means of a turn buckle situated immediately under the detachable footboards. The brake casing is a part of the universal joint, which is correctly designed and fitted with hardened steel bushes. The torque tube which encloses the arbor shaft to the back axle is a special feature. Its forward end is forked, and the attachment to the frame at each side involves the use of rubber rings, which effectively insulate the sprung portion of the chassis from any vibration or harshness due to mechanical connection with the unsprung portion. The final drive is, of course, through Dennis worm gear, which is famous for its silent and smooth running, as well as its great durability and efficiency. Its efficiency is in the neighbourhood of 95 per cent. There is no doubt that the Dennis worm gear, pioneering as it did a development, the merits of which are now fully recognised, has been largely responsible for the silent running of modern motor vehicles, since designers of bevel-driven cars have kept the worm drive before them as an ideal of silent and smooth running, to which it was necessary for them to endeavour to approximate.



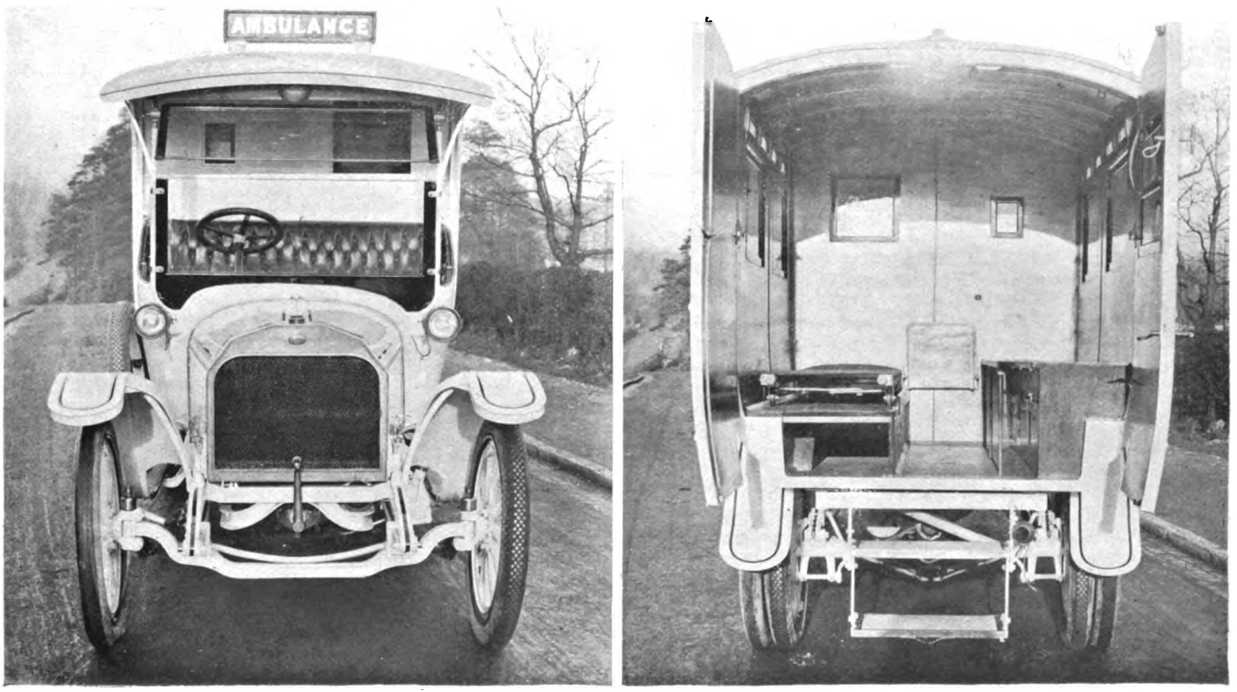
Gear Box of Dennis Ambulance.

In the Dennis gear, the worm pinion is above the worm wheel, ensuring clear lubrication, and allowing a horizontal drive with a minimum of strain on the universal joint. The casing containing the worm gear, differential gear box, and live axles is a special malleable casting with greatly strengthened outer flanges into which are screwed and locked the live axle casings, extensions of which take the bearings of the road wheels. In this system, each wheel has an independent bearing on which to support the weight of the vehicle. The live axle transmits the drive only. Another interesting feature of the new ambulance chassis is to be found in the use of rear springs on the cantilever system. These springs are very long and resilient. Their forward ends are carried in adjustable spring shackles, which can be regulated so that the springs just suit the weight the vehicle has to carry.

Yet another interesting point is the provision along the side members of the frame of stout rubber buffers, designed to insulate the body from direct contact with the metal of the chassis, and so to eliminate vibration and to put an end to the hollow noise which is so often noticeable in the interior of a car body of the closed or box type.

Amongst other features and precautions making for comfort of the patients carried, it may be mentioned that the body is entirely separate from the driver's seat. A leather joint is employed in preference to a metallic joint between the clutch and the gear box, and the wheels of the car are shod with pneumatic tires fitted with detachable rims. The rear tires are twin.

The body is very finely constructed and admirably appointed. Folding steps are provided at the rear, and the doors open the entire width of the body. The regular accommodation for two stretchers can be increased by the addition of another two slung from the roof. Lockers are provided to contain first-aid appliances. There is a seat



Dennis Ambulance for the London County Council.

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for an attendant inside the body and there is an adequate and well-arranged system of ventilation.

Altogether the ambulance is a fine and striking piece of coachwork on a chassis which, for ambulance purposes, represents a marked advance over anything that has hitherto been constructed.

THE NATIONAL STEAM CAR COMPANY AND ITS MEN.

WITHDRAWAL OF SOME LONDON OMNIBUS SERVICES.

As a result of the unreasonable demands made by the men working from the Peckham garage of the National Steam Car Company, two London omnibus services have been suspended and the whole of the men, some 200 in number, discharged. For some time past it had been known to the company that a number of the men at Peckham were dissatisfied with their conditions of employment, and in order to make the company's position clear the following notice was issued to all the men in their employ both at Peckham and Putney:

NOTICE TO THE DRIVERS AND CONDUCTORS.

As some misunderstanding appears to exist with regard to the revised scale of pay recently introduced, it may be useful to explain that the increase in the rate of pay per mile was made in order to shorten the working day, and still to maintain a good living wage. It is the intention of the directors to supplement the wages of all the employees of the company by the payment of an annual bonus according to the results of the year's working, so that the men who have served the company well and faithfully, shall have (with wages and bonus) as high a remuneration as is paid by any other company.

The National Company's present standard wage (apart from bonus) is higher than the lower grades although not so high as the top grades paid by other companies which pay no annual bonus, but with the new bonus added to the wages of the men having a good record for the year, their remuneration will be at least as high or even higher than is paid by any other company.

You could earn more than you are doing for the company by -

(1) Driving more carefully, and so avoiding the many accidents that are costing the company so much money; and

(2) By both drivers and conductors keeping a sharper look-out for passengers, and so improving the traffic returns.

The directors trust that this plan will be loyally supported by all the drivers and conductors of the company. The full details of the profit-sharing or co-partnership scheme will be settled by a conference of the management with an equal number of drivers and conductors selected by yourselves as your representatives, the directors being convinced that this is the best plan in your permanent interests and the company's.

Any driver or conductor who is not willing to give the plan a fair trial is reminded that he is quite free to leave the company's service and to apply for employment elsewhere. Drivers and conductors who are willing to give the plan a fair trial are invited to notify Mr. Clarkson on the enclosed form so that he may receive it not later than Friday morning, January 29. The communications will be treated as private and confidential.

Should the plan explained above receive insufficient support, the directors would prefer to close the garages and dispose of the 'buses.

THOMAS CLARKSON,

January 26, 1915. *Chairman and Managing Director.*

The majority of the men at the Putney garage were quite willing to give the plan a fair trial, but the Peckham men, largely influenced it is suggested by the officials of the Vehicle Workers' Union, were determined to force matters to an immediate issue, with the result that the directors decided to withdraw from service all their omnibuses working from Peckham, and close the garage.

In a statement issued by the company they claim that the service is a good and profitable employment for the drivers and conductors. This is proved by the satisfaction expressed by a decisive majority at Putney. This fact further proves that the Peckham men are unreasonable in not agreeing to continue and to give the company an opportunity of instituting the proposed profit-sharing scheme. The union leaders have, of course, condemned this scheme before it is born, for, apparently, they do not want a reasonable settlement. Until the discharged drivers and conductors realise who are their best friends—the company who lately employed them, trained them at its own expense from unskilled men into men able to earn more wages than those earned by skilled mechanics protected by a trade union, steered them through the examination by the public authority, and set them thoroughly on their feet; or the body of men who are living upon them, and putting them out of work—there can be no peace.

The company does not intend to be exploited by these men; it prefers to shut down and play for nothing rather than work for nothing. The shareholders' capital can be made to earn a dividend elsewhere, and although these union officials choose to gibe at the management upon its threat to dispose of its omnibuses, the management reiterates its intention of sending these machines into the provinces, where there is such an urgent demand, and can do so at a profit. There the matter rests. The company has no need to beg its existence from the drivers and conductors who have received in wages more than six times the amount received by its shareholders whose money runs the wage earning machine; nor from the agitators whose volubility and misrepresentation misleads decent men who are now thrown out of employment.

A certain official of the union states that the 'busmen have been driven into working such excessive hours as to render them a menace to the public safety. The statement is false, as can be seen from the figures taken from the company's books and reproduced below.

The following figures give the hours of work and the pay for the National services, and the public will judge whether the company has been reasonable or not in the past. They have been forced to adopt stronger disciplinary measures in order to prevent accidents and injury to the public, which unfortunately have been on the increase. Complaints from the public of reckless driving, failing to stop when requested by passengers, and discourtesy, have been far too frequent and well-founded. The union officials, instead of co-operating with the company and management, have placed obstacles in the way of securing the necessary reforms.

HOURS WORKED AND PAY RECEIVED.

Dulwich and Shepherd's Bush Route.—Early turn, 8 a.m.-3-47 p.m. Spread over 7 hours 47 minutes. Running time, 7 hours 8 minutes. Mileage, 69 miles. Wages: Drivers, 7s. 5d.; conductors, 5s. 5d.

Late turn, 2-46 p.m.—11-5 p.m. Spread over 8 hours 19 minutes. Running time, 7 hours 20 minutes. Mileage, 69 miles. Wages: Drivers, 7s. 5d.; conductors, 5s. 5d.

Relief turn, 9-14 a.m.-2-26 p.m. and 4-7 p.m.-9-36 p.m. Spread over 12 hours 22 minutes. Actual running time, 11 hours 2 minutes. Wages: Drivers, 9s. 11d.; conductors, 6s. 11d.

Earnings per week.—Early or late turn: Drivers, £2 15s. 2d.; conductors, £1 19s. 5d. (six short and one long day). Relief turn: Drivers, £3; conductors, £2 1s. 6d. (six days).

Shepherd's Bush and Liverpool Street Route.—First car, 6-45 a.m.—6-19 p.m. Spread over 11 hours 24 minutes. Actual running time, 10 hours 14 minutes.

Last car, 8-43 a.m.—9-20 p.m. Spread over 12 hours 37 minutes. Actual running time, 10 hours 58 minutes.

Wages: Drivers, 10s.; conductors, 6s. 11d.

On Saturdays and Sundays country services are run by these cars. Saturday mileage, 121¼ miles. Wages: Drivers, 13s. 2d.; conductors, 9s. 1d. Sunday mileage, 108; drivers, 11s. 8d.; conductors, 8s. 1d.

Earnings per week: Drivers, £3 15s. 4d.; conductors, £2 11s. 9d.

"COMMER" CARS AT THE FRONT.

We are indebted to Commercial Cars, Limited, for several letters which they have received from men at the front, giving interesting accounts of the behaviour of "Commer" cars.

Sergeant Neston Holt, A.S.C.M.T., writes: "I had several "Commer" cars in my charge when I left for France on August 9, 1914. We had a very trying time on the retirement from Mons, even using lorries as barricades. In my train we had all makes, and were losing two or three at a time, the others having to take their loads, which made things much worse. I think I have only lost one of your machines up to date, which speaks for itself, and that with a broken wheel. This machine I put in an hotel yard in Villiers Colleres, covered it with stable straw, and eventually recovered it when the Germans retired during the battle of Aisne. When I was plugged two or three weeks back beyond Ypres, my lot were still running as well as ever."

Private E. Harper, A.S.C., recommends the "Commer" car which he is driving as being able to stand the terrible tests which it is having, and adds that the car seems as good now as when he first drove it.

Private J. H. Williams, A.P.M.T., who has driven a "Commer" car close on 4,000 miles since last August, reports that he has just overhauled it and that all the bearings were in the pink of condition. When the car has been re-tired all round it will be as good as new.

Driver R. W. Poole, A.S.C.M.T., writes as follows: "The work here is most interesting, especially the behaviour of the different cars under most awful road conditions. Talk about roads in England; why they are like palaces compared to the French roads, the majority

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of which are about 10 ft. wide, with a few feet of thick mud on each side and then a beautiful deep ditch. We have a great deal of fun when a car gets stuck in the mud or slides into a ditch. I have not been one of the unfortunate ones yet. It is awkward at night while driving: suddenly a voice calls out "Get over to the right there." Well, if you have any sense you stop where you are and the other chap goes into the ditch, but if you do move in you go and the other chap gets by. It is quite funny sometimes. One of our cars recently went on a run, and when the driver got to a sharp right-hand bend he did not follow the road but went into a ditch at the side and the car turned over in a field, one fellow swimming, two in the field, and one on the car. To make matters funnier, the lieutenant asked them to stop where they were whilst he took a snapshot. It was great. Then on another occasion a fellow tried to take a corner too sharp, a telegraph pole got in the way, but he did not mind: down it went and he went merrily on. This is the sort of work to show the cars for heavy work, and the "Commer" cars have proved to be up to the worst tests. The Daimlers and Albions are also doing some fine work, so are the London General Omnibus B-types, and of all these makes there is not a single complaint. Their running is so consistent and no praise is too high for them."

DAVIS PARAFFIN VAPORISERS.

There can be no question that the high cost of petrol has had a more or less serious effect upon the development of the internal combustion engine. More especially has this been the case with public service motor vehicles, for the very simple reason that the chief factor to be considered when determining the adoption of any particular system is the running costs. In the early days of the motor vehicle the item that concerned the operator most was the tire costs; now, however, reference to detailed accounts which we have published from time to time, in connection with the working of the motor omnibuses in Birmingham, Warrington, Bournemouth, and other places, clearly show that it is the cost of fuel that stands out as the chief item. Under these circumstances it is of special interest to note that the paraffin vaporiser recently placed on the market by Messrs. Geo. W. Green & Co., of Feltham, Middlesex, has not only demonstrated its efficiency, but has also proved that the defects which are generally associated with paraffin carburettors, notably smell and smoke, have been entirely eliminated.

At the invitation of Messrs. Green and Company we recently inspected an engine fitted with the Davis carburettor as well as a standard petrol carburettor, in order that the behaviour of the engine could be noted when working with either petrol or paraffin, the change from one to the other being made from time to time at our request. Although we were assured that the actual consumption of paraffin was even less in quantity than that of petrol, it was quite impossible to detect any difference in the running of the engine, or the nature of the exhaust. A subsequent examination of the sparking plug showed an entire absence of soot. When one remembers that the difference in cost between petrol and paraffin under present conditions is as much as 8d. to 9d. per gallon, it will readily be seen that even on a comparatively small mileage the saving in fuel costs must be an appreciable amount.

The Davis paraffin carburettor is controlled by a throttle valve of the butterfly type, which has been found to be the most convenient form for vehicles; this is operated by the accelerator-pedal in the usual way. Although not actually necessary, it is considered advisable to retain the original petrol carburettor for the purpose of starting up, and at the same time to act as a stand-by. As is well known, a certain heat is required for the vaporisation of paraffin, and this is obtained by starting up the engine on petrol and running it for two or three minutes, when the change over can be made to paraffin. This change is made by means of a two-way valve operated by a pedal by the driver from his seat. The passage-way to the induction pipe is common to each carburettor, and the opening of the paraffin valve automatically closes the admission of gas from the petrol carburettors and *vice versa*.

The Davis carburettor is by no means an experimental apparatus, and as soon as fitted the vehicle can at once, we are assured, be put into service with perfect confidence. Remarkable testimony as to its efficiency and economy is contained in a report from a user in Liverpool. In this case a 4-ton van ran 15 miles out and home on two gallons of paraffin with an average speed of 18·20 miles per hour, the usual mileage of the van being 4½ miles to the gallon of petrol. Being mindful of the fact that many carburettors claiming to admit the use of paraffin have been put upon the market, with anything but satisfactory results, and that a certain prejudice may have arisen in consequence, Messrs. Green and Company, in cases where prospective users have doubts as to the possibilities of their apparatus, are willing to supply a Davis carburettor free of cost, so that any doubt may be dispelled by actual trial before purchase. It is worthy of note that the carburettor is automatic in its action, and that no alteration of foot or hand control is necessary. Owing to the great variations in size of engines and the arrangements of their induction and exhaust piping, it is necessary for full particulars of each case to be submitted before exact prices can be given; it is therefore requested that when inquiries are sent the size and make of engine be given, when a detailed sheet will be forwarded which, when filled up, will enable the makers to quote a definite price.

AVON TIRE EXTENSIONS.

The present year marks the thirteenth anniversary of the establishment of the Avon India Rubber Company, Limited, manufacturers of Avon solid and pneumatic tires for pleasure cars, commercial motors, motor cycles, cycles, etc. It is thus probably the oldest, and certainly the second largest, of British rubber houses now engaged in the tire trade, and with its accumulated experience and resource is entering boldly into the new fields of commercial expansion opened up for British manufacturers by the war.

The Avon Works at Melksham suffered seriously—but gladly—in loss of personnel in the early days of the war. Mr. F. T. Swanborough's joint managing director, Captain Fuller, was called to his Yeomanry unit almost immediately, and 25 per cent. of the staff and workpeople either enlisted or were recalled to the colours during the first few weeks. However, the company's depleted forces have made strenuous exertion to cope with the demand for Avon tires—largely increased, of course, by exceptional War Office and Admiralty calls—and, so far from marking time until the advent of normal conditions, the company is redoubling its efforts to augment both its manufacturing and selling facilities.

Men serving with the colours have been assured of employment upon their return, and their dependants are being generously assisted, but extensions already decided upon will find permanent room for a large number of extra workers who, in the meantime, are being set to fill the "enlistment gaps" as quickly as they can be secured. In addition to the extensive motor tire workshops opened last summer, the erection of fresh buildings and the instalment of new plant sufficient to double the present enormous output of pneumatic tires for pleasure cars and solid band tires for commercial motors—will be undertaken immediately, so that when peace reigns again the Avon Company will be in a position to meet new demands and will, no doubt, reap adequate reward for its courageous investments.

Meantime the works are "carrying on" at high pressure, and every possible effort is being made to maintain supplies. The requisitions of the War Office and Admiralty must, of course, come first, but it is hoped to avoid imposing any shortage upon home traders and motorists. Along the line of service the Avon Company is establishing a number of new distributing depots at important centres, at all of which full stocks will be held and hydraulic presses installed for the fitting of commercial "solids."

At Newcastle, the premises recently "evacuated" by the Continental Company have been "captured" for British Avons, and no doubt the sympathy of Tyneside traders and motorists will quickly create impregnable entrenchments. The address is 5, Gallowgate, and the premises are, of course, already fully equipped specially for the tire trade.

Birmingham has been an Avon stronghold for some years, and the present buildings in Corporation Street, although recently enlarged, have been outgrown. The business is now being given a new home in the ground floors and basements of the handsome new building situated at the corner of Broad Street—4, Broad Street Chambers. Convenient storage for all classes of goods will be arranged for, and in addition to the hydraulic tire press there will be a special lift for dealing with heavy articles. The back entrance provides ample room for large commercial vehicles to drive in for the instant changing of tires.

Agents and private users will be saved much time in delivery by the new Avon depots at Aberdeen and Swansea. At Aberdeen, suitable premises have been acquired at 106, Union Street, the principal thoroughfare, consisting of ground floor offices and two large basement stock rooms. At Swansea, the new address is 42 and 42a, Fisher Street. The Nottingham territory will soon be served from roomy warehouses and offices, centrally situated in the main Mansfield Road, close to the Great Central and Great Northern Railway Stations. Commercial vehicles can here be actually driven into the building, and have replacement tires pressed on under complete cover. The warehouses, offices, and show rooms are also exceptionally well adapted for the tire trade, and the depot will unquestionably be one of the best yet established for Midland motor traders.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

THE SOUTHEND TOWN COUNCIL have accepted the tender of Messrs. Merryweather and Sons for the supply of a petrol-driven fire engine of the "Hatfield" type, capable of delivering 400 gallons per minute.

ORWELL ELECTRIC VEHICLES.—Messrs. Mossay and Company, Limited, who are the selling agents in Great Britain and Ireland for the "Orwell" electric vehicles, have removed from their premises in Horseferry Road to Queen Anne's Chambers, Westminster, S.W.

STANDARDISED BALL BEARINGS.—At the request of the Society of Motor Manufacturers and Traders, the Engineering Standards Committee have issued an interim report on British Standard sizes of single-row ball bearings for automobiles. A complete report will be issued later.

AMERICAN CARS FOR OUR ALLIES.—A large number of American built cars are now under construction for our Allies. Amongst the recent orders which have been placed is one for 300 5-ton lorries with the Pierce-Arrow Motor Car Company, of Buffalo, and a similar order with the Peerless Motor Car Company, of Cleveland.

A MANCHESTER MOTOR SHOW.—We understand that a motor show under the auspices of the North of England Motor Shows, Limited, of which Mr. F. Bullock is the manager and secretary, has been arranged and will be held at the Ice Palace, Derby Street, Manchester, from April 16 to 24 next. The sections will include commercial vehicles, pleasure cars, motor cycles, tires, and accessories.

NEW OMNIBUSES FOR BIRMINGHAM.—At a meeting of the Birmingham Tramways Committee on January 20, Mr. Harrison Barrow presiding, it was decided to adopt the recommendation of the general manager (Mr. A. Baker) to purchase 10 new motor omnibuses to take the place of those commandeered by the War Office. These additions to the existing fleet will enable the department to improve the Northfield and Harborne services.

A NEW ARROL-JOHNSON 2½-TON CHASSIS.—A new worm-driven model designed for a paying load of 2½ tons has just been completed at the Dumfries works of this well-known Scotch firm of motor car builders. It is fitted with a 4-cylinder engine with 91·5 mm. bore and 140 mm. stroke, and having an automatic governor. There is also an automatic ignition advance. Forced-feed lubrication is employed, while the cooling arrangements are on the thermo-syphon principle.

MOTOR OMNIBUSES AT ADELAIDE.—Ten Daimler motor omnibuses were ordered in July last by the Municipal Tramways Trust of Adelaide. The report of the general manager, recently received, states that in ordinary circumstances these vehicles would have been ready for traffic by October 31, but owing to the outbreak of war all the omnibuses being built by the Daimler Company were taken by the British Government. It is hoped, however, that some vehicles will be ready early this year.

MELBOURNE MOTOR OMNIBUSES.—The amalgamation of the two motor omnibus undertakings in Melbourne, Australia, was confirmed at a recent meeting of the shareholders of the companies. The Melbourne General, as the amalgamated company will now be known, has a combined fleet of 38 vehicles, Daimlers and Tilling-Stevens. With these under one management it is possible to give an efficient service on three routes, and as soon as the chassis now on order in England are available several other routes will be opened up.

MOTOR *v.* HORSE IN LAMBETH.—The Lambeth Borough Council have for many months past had under consideration a proposal for the building of new horse stabling on an extensive scale. A persistent opponent of the scheme, Councillor J. C. Mitchell, strongly advocated the adoption of motor appliances for the whole of the street cleansing department. We are glad to know that at a recent meeting of the Council it was decided to abandon the expensive scheme for building new horse stables, and to at once place orders for street cleaning motor machines.

NO OMNIBUSES FOR GLOUCESTER.—The Gloucester Corporation have refused to grant an application by the Bristol Tramways and Carriage Company for licences to run six motor omnibuses, on the ground that the vehicles are not required within the city. The intention of the company was that the omnibuses should run between Gloucester and Tewkesbury, and Gloucester and Ledbury; and in order to prevent competition within the city with the Corporation's tramcars, the company were willing to charge fares there at least double those charged on the tramways.

MOTOR OMNIBUSES AT READING.—In their Act of 1914 the Reading Corporation obtained sanction to run motor omnibuses within the borough, and on the recommendation of the Tramways Committee two double-deck and two single-deck omnibuses were obtained from the Daimler Company. At the time when these vehicles were purchased war broke out, and the War Office commandeered the chassis. Since then the Daimler Company have been engaged in the manufacture of chassis for the War Office, and the Corporation have not yet been able to obtain omnibuses for their own use.

MOTOR FIRE ENGINES.—Amongst the various municipal and local authorities who have under consideration the purchase of motor fire appliances are the following: Birmingham City Council, Batley Town Council, Southampton Town Council, Birkenhead Town Council, Hyde Urban District Council, Abercorn Urban District Council, Sowerby Bridge Urban District Council, Exmouth Urban District Council, Acton Urban District Council, Earlstown and Newton Urban District Council, Crayford Parish Council, and the Joint Fire Brigade Committee of Farnham (Surrey) and the surrounding districts.

MERCÉDÉS-DAIMLERS FROM U.S.A.—The General Vehicle Company, Limited, of London, have completed arrangements for the manufacture of the Mercédés-Daimler commercial chassis in America. We understand that although all the dimensions have been transferred to British measure the design has been accurately copied. The first machine to arrive in this country is the 5-ton model; this is fitted with a 4-cylinder engine, 4·25 in. bore and 4·9 in. stroke, with overhead valves. The frame is of pressed steel, and the rack and pinion drive, which has always been a special feature of the Mercédés design, is again in evidence.

MOTOR MOBILISATION IN TORONTO.—In connection with the training of the second Canadian contingent a motor mobilisation from the Exhibition Grounds to Queen's Park, in Toronto, was successfully carried out on December 18. Some 600 cars were employed, all sizes and makes taking part. Prominent in the procession were the three armoured cars which are destined to accompany the contingent to Europe. These were built to the order of the Canadian Government by the Pachard Motor Car Company, of Detroit, Michigan, U.S.A., and are of the 38-H P. 6-cylinder type. In the special armoured body a Colt quick-firing gun is mounted in a turret fitted with ball bearings, so that the operator from his position inside the turret can easily direct the gun in whatever direction may be required.

ROAD IMPROVEMENTS IN AUSTRALIA.—The extension of motor traffic in Australia has brought the question of suitable road construction prominently before the authorities in each of the large cities, and in this connection the Victorian Government is to be congratulated upon the spirit in which they have approached the matter and the practical steps they are taking to meet the altered conditions brought about by the development of motor transport. During the past year a sum of £2,000,000 has been authorised for expenditure for the purpose of road improvement, and a comprehensive scheme, whereby it is proposed to utilise the unemployed for this work, has been proposed. As may be expected, there is considerable opposition from vested interests, but so popular is the Government scheme becoming that an active campaign is already in operation for the purpose of opposing the election of all candidates for municipal honours who are not in favour of road reforms. The arrangements for the expenditure of the £2,000,000 are in the hands of the County Road Board, and at a recent public meeting the chairman of this authority stated that, anticipating the rapid development of motor transport would supersede railways in many districts, it was their intention to construct roads fit to carry the traffic of the future.

MR. A. S. MANN, having resigned his position with the London County Council Tramways, has been appointed examiner in the drawing office of Messrs. C. A. Vandervell and Company, of Acton.

MR. KERR-THOMAS, of the Pierce-Arrow Company, U.S.A., has been joined by Mr. Norris, who, until quite recently, held the position of sales manager in the commercial vehicles department of Napier Motors Limited.

MR. J. F. HENDERSON, works manager to the Albion Motor Car Company, gave an interesting lecture on magnetos before the Scottish centre of the Institute of Automobile Engineers at their meeting on January 18.

MR. GILLIES, who for some time past has been in charge of the Leyland Motor Company's business in Scotland, with offices in Bothwell Street, Glasgow, has joined their selling staff in London, as the company has decided to close their Glasgow office during the war.

MR. JOHN MUIR has taken up an important position in the solid tire department of Wood-Milne, Limited, of Preston. Mr. Muir, who has had many years' experience in the tire business, was, until recently, sales manager for the Continental Tire and Rubber Company, Limited.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

Founded 1892. LONDON, MARCH 11, 1915. VOL. XXXVII.

THE BIRMINGHAM DISTRICT TRAMWAYS AND MOTOR EXPRESS.

AN IMPORTANT DEVELOPMENT IN LOCAL TRANSPORT.

The Tramways Parcels Express, known as the "T.P.E.," connected with the five companies operated by the Birmingham and Midland Tramways Joint Committee, an offshoot of the British Electric Traction Company, was inaugurated on November 1, 1905. These companies were as follows: The City of Birmingham Tramways Company, the Birmingham and Midland Tramways (now the Birmingham District Power and Traction Company), the South Staffordshire Tramways (Lessee) Company, the Dudley, Stourbridge, and District Electric Traction Company, the Wolverhampton District Electric Tramways, and the Birmingham and Midland Motor Omnibus Company. At that time, apart from one short route from Steelhouse Lane to Aston Cross, all the tramway routes inside Birmingham were under one control, and practically all parcels were dealt with by means of tramcars, on the platforms of which they were taken to the agencies or offices on the various tramway routes.

From about the middle of 1906 the tramway lines inside Birmingham began to pass over to the Corporation under the operation of the 1870 Act, and the last one to become municipalised happened to be the main parcels express tram route into the Black Country. This line came under municipal management in June, 1911. The area served by the Tramways Parcels Express at this date was comprised roughly within the parallelogram Birmingham-Walsall-Wolverhampton-Dudley, besides the network of lines extending from Dudley south-west to Kingswinford, Brierley Hill, Stourbridge, and Kinver. The deliveries at this time were mostly carried out by means of hand carts from the Tramways Parcels Express agencies and offices.

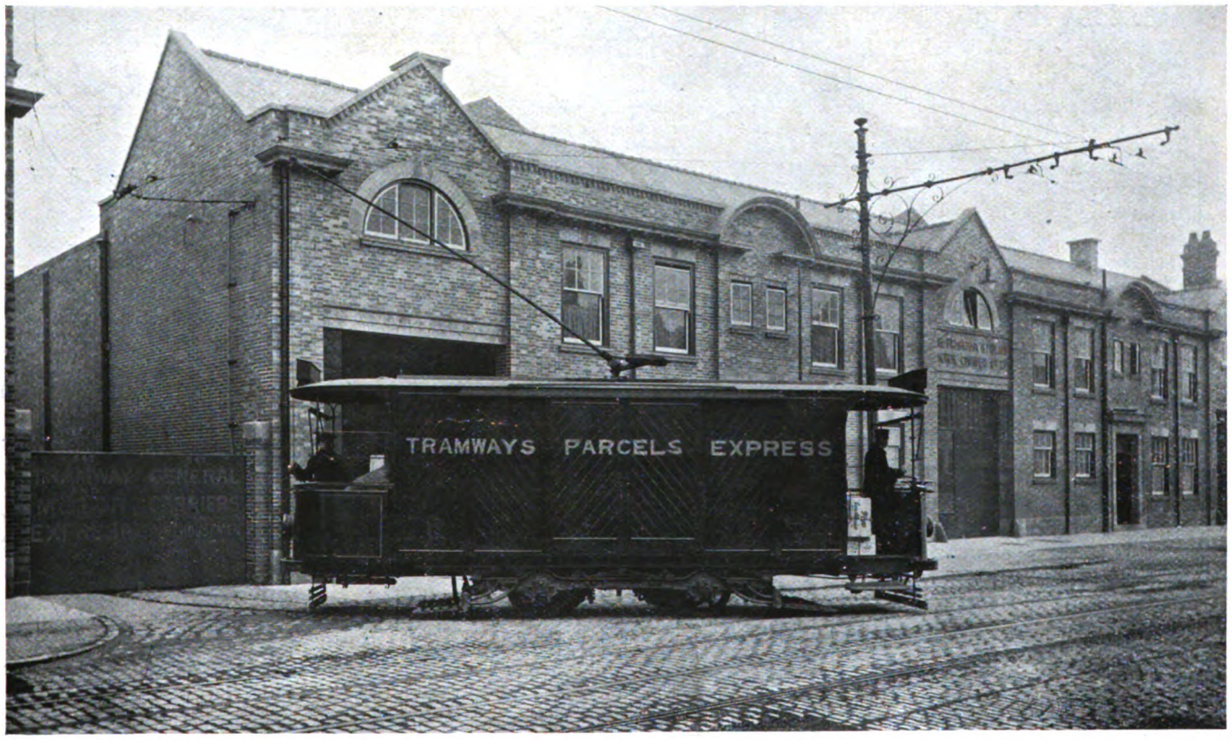

Fig. 1.—Type of Baggage Car Employed on the Birmingham and Black Country Tramways Parcel Service.

Gradually, however, the traffic increased in volume and, in addition, the business began to be rather that of a general carrier. Trade packages became frequent, and the tendency was for them to get heavier and beyond the carrying capacity of the ordinary car platform. In addition to this, the Corporation of Birmingham, over whose lines the Joint Committee cars by arrangement have access into the "Hub" of the

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Midlands, were averse to the carriage of parcels or packages on the car platforms inside the city, and it became necessary, in order to preserve the continuity of the service between Birmingham and the Black Country, to think out some other mode of tramway transit. Hence the idea was evolved of baggage cars constructed to take packages of any reasonable size or weight, which were devoted exclusively to the carriage of this traffic and ran to a schedule time-table between principal points. At the present time, whilst the ordinary tramcars are still used to carry parcels on the branch lines, the main lines are now worked by baggage car services. A good number of these baggage cars are now in operation and additions are in contemplation. The cars run from point to point as required, giving a connection, practically four times daily, between all parts of the Black Country tramway system and the city of Birmingham. A good idea of the type of baggage car employed on this service is given by Fig. 1. Seeing, as previously mentioned, that the character of the traffic altered so largely, it became necessary to provide cartage staffs in the chief towns to execute the necessary collections and

Fig. 2.—Transferring Parcels from Car to Distributing Van at Lionel Street Office, Birmingham.

principal traders' premises are situate on the line of route. Hence delivery can be made in many cases direct from the baggage car. Arrangements have also

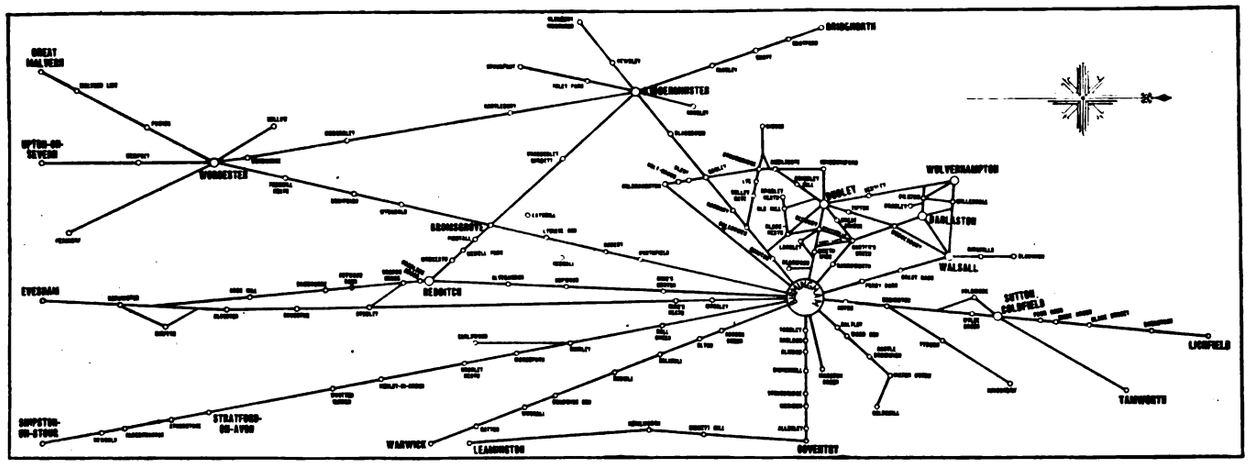

Fig. 4.—Diagrammatic Map of District Served by Tramway and Motor Express.

deliveries and to reduce the use of hand carts to a minimum.

An important factor in the success of this tramway parcels express system is that a large percentage of the

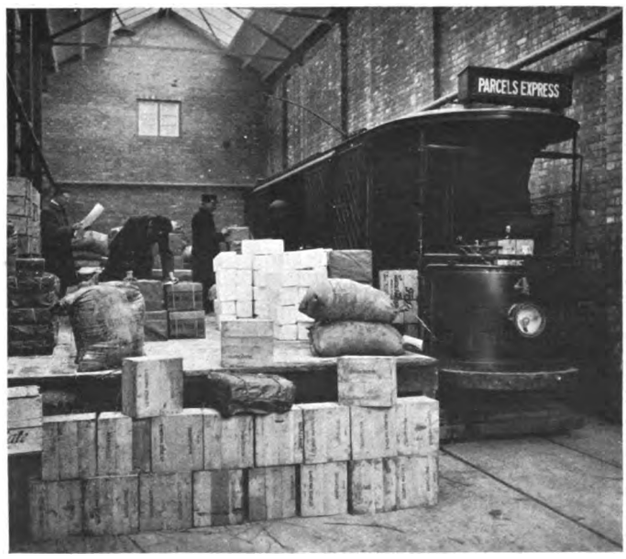

Fig. 3.—Interior View of Tramways Parcels Express Warehouse.

been made with the Walsall Corporation by which these baggage cars run over their lines, thus giving the Walsall traders the benefit of a rapid and efficient parcels service.

Although, owing to the different method of traction (surface-contact as against overhead trolley), the baggage cars do not run into Wolverhampton, they run to the boundary, and horse vans and motors collect and deliver from these points. Before long it is anticipated that it will be necessary to do all the local collecting and delivering work by means of motor vehicles, and tests have been and are being carried out with this in view.

The number of packages handled per annum has risen from some 150,000 in 1906 to upwards of 400,000 in 1913 and 450,000 in 1914. There are 13 depots and 115 agencies with a staff of 157. The baggage cars cover a mileage of approximately 700 miles weekly, and the cost of working them, estimating an average load of five tons per car per mile, comes out at a very minute fraction of a penny per ton-mile. The tramways run over have a total route-mileage of 65½, exclusive of the 5½ route miles inside Birmingham and the 1¼ route miles inside Walsall.

In addition to the ordinary parcels traffic in the district served by the tramways, daily consignments of goods are now being sent by rail in bulk to the office in Birmingham (Fig. 2) for all the places covered. This traffic is generally loaded direct from the cartage drays into the baggage cars, which immediately set out

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upon their distributing journey, so that packages handed in at Birmingham by 8-0 a.m. are in consignees' hands a few hours afterwards, even when the places are 12 to 14 miles distant. This method presents considerable advantages in the direction of saving in time and in cost, as compared with sending packages individually direct by rail. Whereas packages from all the principal towns in Great Britain get a rapid transit by rail to Birmingham, it is quite a different matter getting them quickly to adjacent towns and villages, and traders have found out the great benefit derived from taking advantage of bulking to Birmingham and leaving the distribution in the hands of the tramway and motor express.

Following up this idea and in response to inquiries, a large depot (see Fig. 3) has been erected at Bearwood (one of the suburbs of Birmingham) to deal exclusively with goods and parcels traffic. Constructed on modern

Fig. 5.—Single-Deck Motor Omnibus Equipped with Parcel Tackle.

designs and capable of being heated to any required temperature, it is connected with sidings to the tramway line and is provided with loading decks, so that the baggage cars can run in direct for loading and unloading; consequently this depot is capable of accommodating traffic by the ton. Every facility is given for storage; packages can be sent down in bulk by rail or canal and stored, and can thus be on the spot for distribution immediately on receipt of orders from any firm taking advantage of the system. This enables firms whose manufacturing premises are situate in other parts of the country to give their customers as prompt a delivery as if their factory were situated next door to the customers' premises; moreover, it saves a considerable amount of clerical work. Another point not to be overlooked is the fact that if there should be a railway strike or if the railways should be held up in any way, either occurrence need not be a disturbing factor, as on this system there is a store of goods on the spot ready to be delivered.

In conjunction with all this the Tramways Parcels Express is extending its operations by means of the big fleet of "Midland" motor 'buses working from the large modern garage adjacent to the Bearwood parcels depot. These omnibuses link up all the towns in the neighbourhood of Birmingham and run several times daily to such places as Coventry, Worcester, Warwick, Kidderminster, Redditch, Evesham, Leamington, Stratford-on-Avon, Droitwich, Malvern, etc., etc. (Fig. 4). Being single-deckers mostly, it has been possible to make the roofs specially strong and to fit them with rails. To facilitate quick and safe handling, ladders are fixed at the back, ropes and hooks provided to lift the packages on and off, and as a protection from the weather, a thick tarpaulin sufficient to cover the whole of the roof is added and strapped down to the side rails (see Fig. 5). By these means packages up to one hundredweight can be safely and quickly handled.

Although the parcels motor 'bus development has only been in operation some nine months, the number of packages handled is increasing rapidly. Farmers, nurserymen, florists, and others are sending their produce into Birmingham, thus obtaining an early market; *vice versa*, the manufacturers and traders of Birmingham send their various products outwards. The carpet industry of Kidderminster, the smallwares manufacturers of Redditch, and the sundry manufacturers and traders at other places find by this means the very thing they require.

In addition, omnibuses leave Birmingham daily for Redditch, Kidderminster, Walsall, Solihull, Stratford, Shipston, Sutton, Four Oaks, Bromsgrove, Worcester, Malvern etc., with bundles of early morning newspapers.

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Leaving the centre of Birmingham between 5-30 and 6-0 a.m. they arrive at these places still in the early morning, putting off their parcels *en route* and giving the inhabitants, through the retailers, the privilege of being able to read the latest London news at breakfast. This is, we believe, the first motor 'bus system to tackle this important business in anything like a systematic manner. Early morning Sunday newspapers have not been overlooked, and some of the principal London weeklies are dealt with on motor 'bus lines.

The officer primarily responsible for this interesting parcels business is Mr. E. A. Mellor, who gained his first tramway parcels experience in the Potteries, and who came to Birmingham in 1905 to organise a similar system in that town, under the direction of the general manager (Mr. W. S. Bond) of the Birmingham and Midland Joint Committee.

NEW SWING BRIDGE AT DALMUIR.

The new swing bridge at Dalmuir, carrying the main road and the tramways between Glasgow and Dumbarton over the Forth and Clyde Canal, which was opened for public traffic on February 10 is specially interesting, on account of the very complete system of electric control which has been installed. The old bridge was a narrow timber double-leaved bascule bridge, a mere renewal of the bridge constructed when the canal was opened through to Bowling in 1790, and it had become hopelessly inadequate for the traffic of the district.

It was the advent of electric tramways, however, which rendered the improvement indispensable. The Glasgow Corporation tramways, having been extended through Clydebank, came to a dead-end at this bridge, which was an impossible structure from a tramway point of view. But the terminus of the Glasgow lines was two or three hundred yards west of the bridge, and some seven or eight years ago the further question arose of through communication with the Dumbartonshire tramways, which were being opened, and whose eastern terminus lay near the western terminus of the Glasgow lines. To save through passengers a five or ten minutes' walk from the one system to the other, a new bridge with the tramways on it was necessary, and after the usual contention between local interests the matter was arranged, and the bridge was erected.

The new bridge consists of a single swing span constructed of steel, the foundations and pit walls being of concrete. The clear opening of the canal is 20 ft., but owing to the width of the new bridge and the uncertain condition of the existing abutments, the total length of the swing span is 78 ft. 5 in., the radius of the nose end being 53 ft. 2½ in., and that of the rear end 25 ft. 2½ in.

The two main girders are of the plate-girder type, 6 ft. deep over the pivot, and placed 21 ft. 6 in. apart between centres. There is a clear roadway of 20 ft. in the centre of the bridge and on the outside of the main girders there are footpaths 5 ft. wide, carried on projecting brackets. The floor of the roadway consists of longitudinal runners of red pine 5 in. thick, laid on the top of the steel cross girders, which are 4 ft. apart. The wearing surface of the roadway is 2 in. larch planking laid across the longitudinal runners, and the footpaths are laid with longitudinal larch planking 2 in. thick. A double line of tramway is laid on the roadway, and the rails are of the Glasgow Corporation Tramways standard section, weighing 110 lb. per lineal yard. The rails are supported on the steel cross girders and on longitudinal steel joists.

The bridge is of the centre bearing type, and practically the whole swinging load is carried on a centre pivot. The pivot has a spherical bearing to allow of a slight bascule movement for the purpose of lifting the nose ends of the main girders out of the bearing sockets. At each end of the pivot girder there is a roller carriage with two rollers, but these are only for steadying purposes. The bridge is so balanced with cast-iron kentledge that there is an overturning moment at the rear end, and when the bridge is swinging the rear end is supported on a single roller running on the same track as the steadying rollers. When the bridge is in position for road traffic the rear ends of the main girders are lifted up by end jacks, and the bridge is then supported at both ends and on the pivot.

The turning gear is of simple construction. An electric winding winch fixed in the operator's cabin is connected by a continuous wire rope to a circular drum underneath the bridge. The end lifting jacks are of the ordinary screw type, and are operated through shafting by an electric motor in the operator's cabin. The safety gates on the approach roadways are also operated electrically. The gates are of the usual railway-crossing type, and each pair is connected together by sympathetic levers. An electric motor driving suitable worm gear operates each pair of gates.

The overhead wires on the bridge are carried on latticed steel poles and cross girders erected on the top of the main girders. Similar poles and cross girders are erected on the approaches, to which the overhead wires are suitably attached. The trolley wires on the bridge section are connected to those on the approaches by a flexible cable near the rear end of the bridge, thus avoiding sliding contacts in the overhead work.

A complete system of electrical control has been installed, and all the operations are interlocked. The operator's cabin is close to the bridge, and the operator has a clear view of the canal and approach roadways. Various schemes of electrical control for the working of the bridge were considered by the Glasgow Corporation Tramways Committee and the officers of the Caledonian Railway Company, and finally it was decided to adopt the "Igranic" system submitted by Messrs. Osborne and Hunter, Glasgow. Under this system the whole of the operations are controlled by a small master switch in the operator's cabin.

When the bridge is being opened to allow canal traffic to pass, the operating movements are as follows:

1st Movement.—Semaphore signals on the approach roadways are set to danger and alarm bells are rung.

2nd Movement.—The electrical supply is cut off from sections of the tramway overhead wires on the approaches, and the catch points on the tramway tracks are opened.

3rd Movement.—The safety gates on the west side of the canal are partially closed.

4th Movement.—The safety gates on the east side of the canal are partially closed.

5th Movement.—The safety gates on the west side of the canal are fully closed.

6th Movement.—The safety gates on the east side of the canal are fully closed.

7th Movement.—The end lifting jacks under the short end of the main girders are lowered.

8th Movement.—The bridge locking bolt is withdrawn.

9th Movement.—The bridge is swung.

To open the bridge for road traffic the foregoing operations are reversed.

The engineers for the bridge were Messrs. Crouch, Hogg, and Easton, C.E., Glasgow, and they had the advantage of the advice and assistance of Mr. James Dalrymple, general manager of the Glasgow Corporation Tramways, and his staff.

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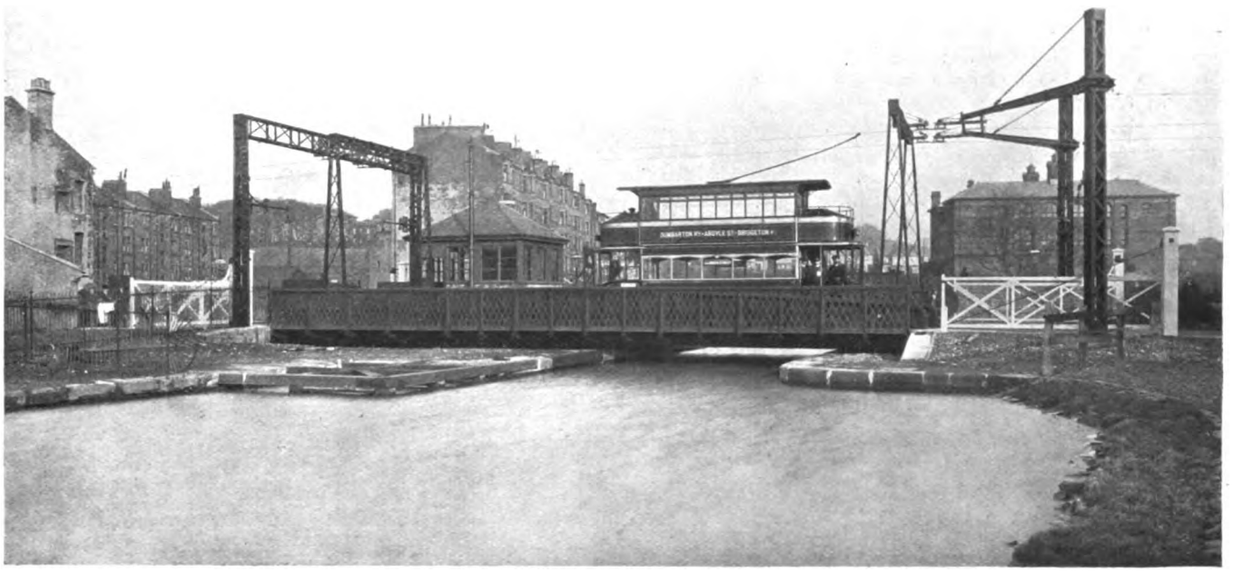
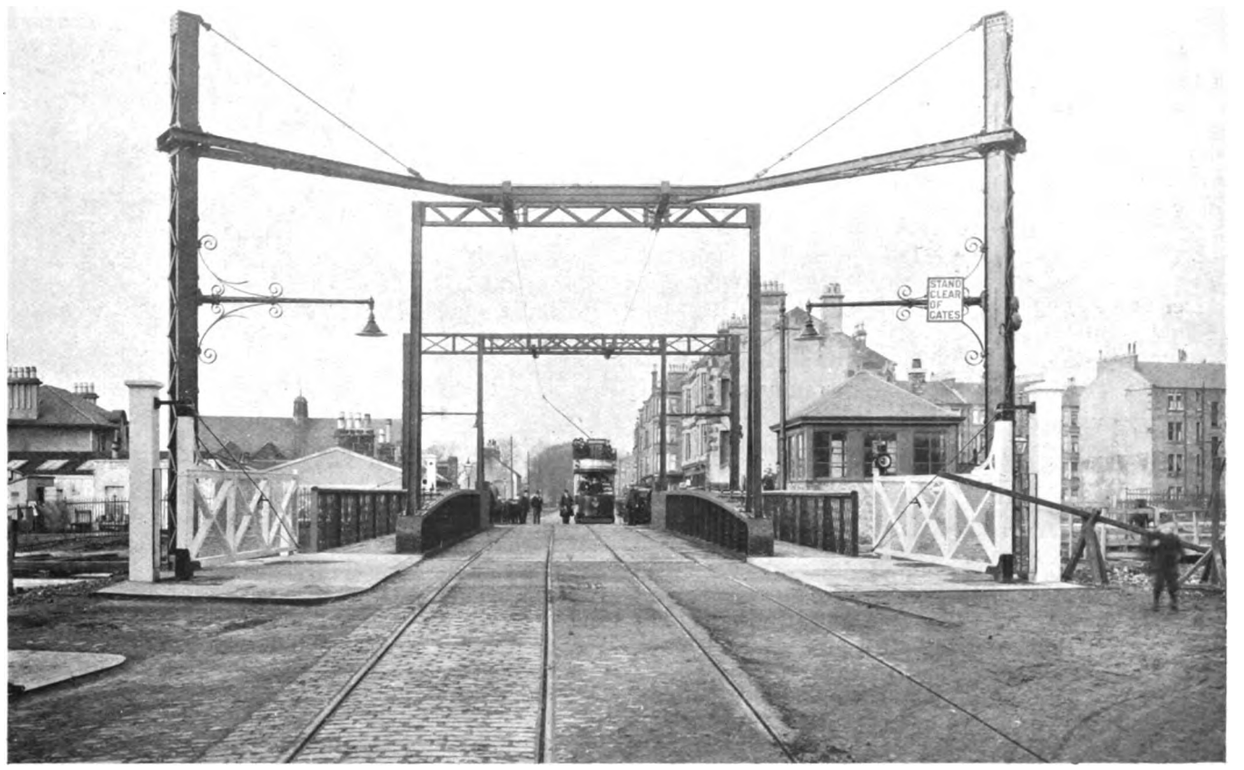


Glasgow Corporation Car Crossing the New Swing Bridge at Dalmuir.



View Across the New Bridge at Dalmuir.

This bridge enables tramway cars to be run between Glasgow and the Dumbartonshire district, and makes possible a through service from Glasgow to Loch Lomond. The contractors for the construction of the bridge were Messrs. Robert McAlpine and Sons, Clydebank, and they entrusted the construction of the steelwork and machinery to the Brandon Bridge Building Company, Limited, of Motherwell.

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ELECTRIC TOWING LOCOMOTIVES FOR THE PANAMA CANAL.

The cutting of the isthmus dividing the Atlantic and Pacific Oceans and joining North and South America, has fired the imagination of civil engineers for years upon years. Ferdinand de Lesseps first started the huge undertaking, but he was beaten by the magnitude of the work and the deadliness of the climate to the men employed on the work and by the rapacity of the financiers whose help he sought. The amount of earth shifted by the French under these circumstances was remarkable, and many of their machines after years of neglect have been cleaned up and put to good use to the last. The elimination of the stormy passage round Cape Horn on many ocean routes will bring lands hitherto far apart into easy access by water. This will revolutionise many channels of commerce—closing a few but opening a great number of new streams of traffic. The accomplishment of this great undertaking has fallen to the United States of North America, who have successfully completed one of the most gigantic engineering tasks that has ever been set to men. Disease was blotted out by the skilful organisation of the men in charge; labour and labour-saving devices were provided; and the present chief, Colonel Goethals, has given full credit to the genius of those who preceded him, whose labours he has brought to a conclusion by a continuity of his predecessor's talents supplemented by his own indomitable energy and special gifts for the work.

The low-level canal having been abandoned owing to reasons of cost and of danger from floods, locks had to be introduced. It is in the design and carrying out of these that the boldest work has been done and the greatest originality has been shown. One of the most remarkable and original features of the arrangements is the mode of towing vessels of every size through the long flight of locks, where it has been found necessary to have ships under the strictest control both on account of the magnitude of the work that would be endangered by any carelessness, and also on account of the curious eddies and whirls caused by the meeting of the fresh water from the lakes and the salt water of the sea. Only the passage of a vessel from the Atlantic through the canal to the Pacific can give a true idea of the difficulties that have been overcome. Such a vessel will first enter the approach channel in Limon Bay, which extends to Gatun, a distance of about seven miles. At Gatun it will enter a series of three locks in flight, and be raised 85 ft. to the level of Gatun Lake. It may then steam at full speed through the channel in this lake, for a distance of 24 miles, to Bas Obispo, where it will enter the Culebra Cut, which is nine miles long, and reach Pedro Miguel; a lock here will lower it 30 ft. Then it will pass through Miraflores Lake for a distance of 1½ miles until it reaches Miraflores, where it will be lowered 55 ft. through two locks, to the sea level; after which it passes out into the Pacific at Panama through an 8½-mile channel.

The main features of all the lock sites are identical:

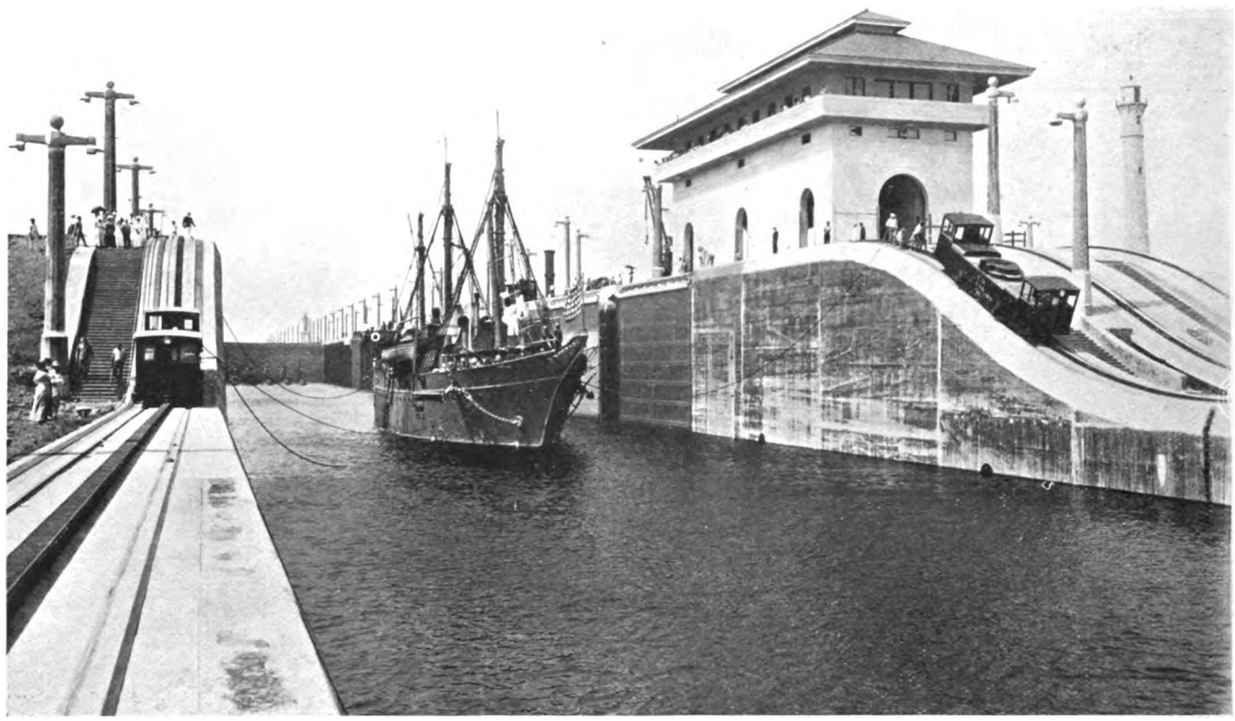

Fig. 1.—Electric Towing Locomotives Taking Vessel from the Upper East Chamber at Gatun Locks.

and a description of the Gatun Locks will give a good idea of the towing scheme in general. It should be first noted that after a very thorough study of the problem of manœuvring ships through the locks of the canal, it became evident that they should not proceed through the locks under their own power, and that a substitute for the ship's power should embrace the following requirements: (*a*) Ability to place the ship in proper relation to the lock, (*b*) capability of keeping the ship to its course, (*c*) accelerating and retarding the ship without rupturing the lines, (*d*) the lines when once attached should be used without change for lockage in flight, (*e*) a small number of skilled operators rather than a large number of unskilled men to co-ordinate.

The system adopted was designed and patented by Mr. Edward Schildhauer, electrical and mechanical engineer of the Isthmian Canal Commission; and 40 towing locomotives and all the electrical apparatus for operating the locks were built by the American

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Fig. 3.—United States Sub-Marine Tender "Severn" in Control of Four Towing Locomotives in a Gatun Lock. The Water is about to be Lowered.

General Electric Company on the Schenectady towing system.

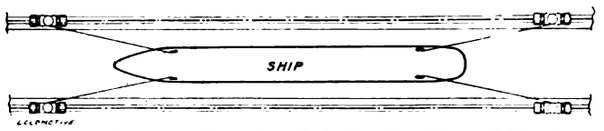

Fig. 2.—Diagram Showing Relative Position of Towing Locomotives, Cables, and Ship.

In the Gatun Locks there are two ship channels, one for traffic in each direction. The channels are separated by a centre wall, the total length of which is 6,330 ft. On the outer walls there are two systems of tracks, one for towing and the other for the return of the idle locomotives. On the centre wall there is only one return track in common for both the towing tracks. These are, of course, placed next to the channel side, and the towing is generally effected by four locomotives running along the lock walls. Two of them are opposite each other in advance of the vessel, and two run opposite each other following the vessel, as indicated in Fig. 2. The number of locomotives is, however, increased when the tonnage of the ship demands it.

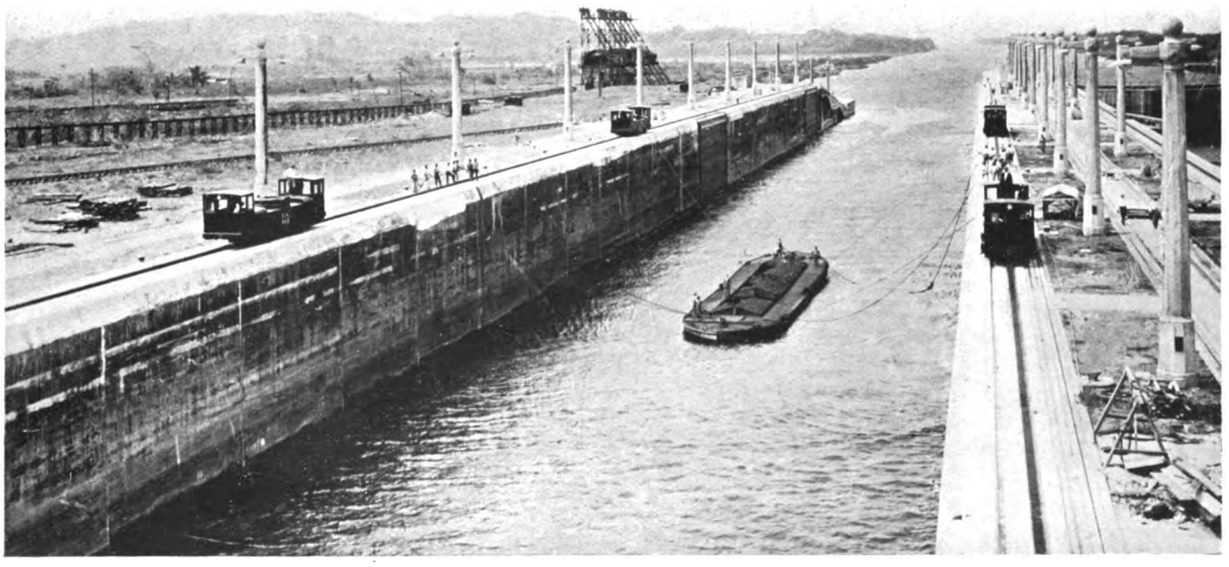

Fig. 4.—The First Trial Run of the Electric Towing Locomotives at the Gatun Locks.

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The locomotives are connected with the vessel by four couplers; the lengths of these are adjusted by a special winding drum on the locomotive so as to place the vessel as near as possible in mid-channel. The leading locomotives do the towing while the trailing locomotives keep all the cables taut. By changing the lengths of the rear cables, the vessel can be guided; and to stop the vessel, all the locomotives are slowed down and stopped, thus bringing the rear locomotives in action to retard the ship. Therefore, the vessel is always under complete control quite independent of its own power, and the danger of injury to the lock walls and gates is very greatly lessened. Figs. 1-4 give a general idea of the method of handling vessels, and they also show general views of the lock walls, towing tracks, and the inclines, the steepness of the latter being especially noticeable. Of particular interest is Fig. 4, which represents a trial tow approaching the second level. The water in the middle lock, or at this second level, is at sea level, a condition not obtained in regular operation, and this trial was made to demonstrate that the tow lines would clear the lock walls.

The towing tracks have a specially-designed rack rail extending the entire length of the track and located centrally with respect to the running rails. It is through this rack rail that the locomotive exerts the traction necessary for propelling large ships and climbing the steep inclines. A rack rail is also provided on short portions of the return track so as to lower the locomotives safely from one level to the next. The steepest slope is 1 in 2·3, hence the need will be seen for rack rails even on the return track.

A small portion of rack rail is shown in Fig. 5, A being the rack rail proper and B the approach to it. B is hinged at C so that it can be depressed on the approach of the rack pinion of the locomotive. The teeth of the approach section are under size and shaped off at the extreme end so that the teeth of the pinion will mesh properly and prevent excessive strain on the pinion and the axle. The spring D restores the approach to the proper position after the locomotive has passed over; there is one of these movable sections at each end of the rack rail. The rack rail is of the

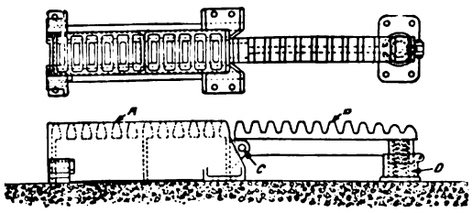

Fig. 5.—A Section of the Approach Rack Rail.

shrouded type, and each tooth space has a drain hole cast in the bottom so as to carry off water and other accumulations to suitable drain pipes or ducts set in the concrete of the walls. A further feature of the rack

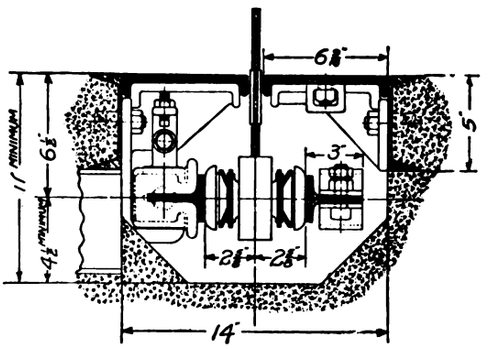

Fig. 6.—Section of Conduit Showing Current Collecting Device for Two Phases and the Underground Rails from which Current is Taken.

rail is the projecting edges, which permit thrust wheels attached to the locomotive to run along the under side and prevent overturning of the locomotive in case some unforeseen operating condition should produce

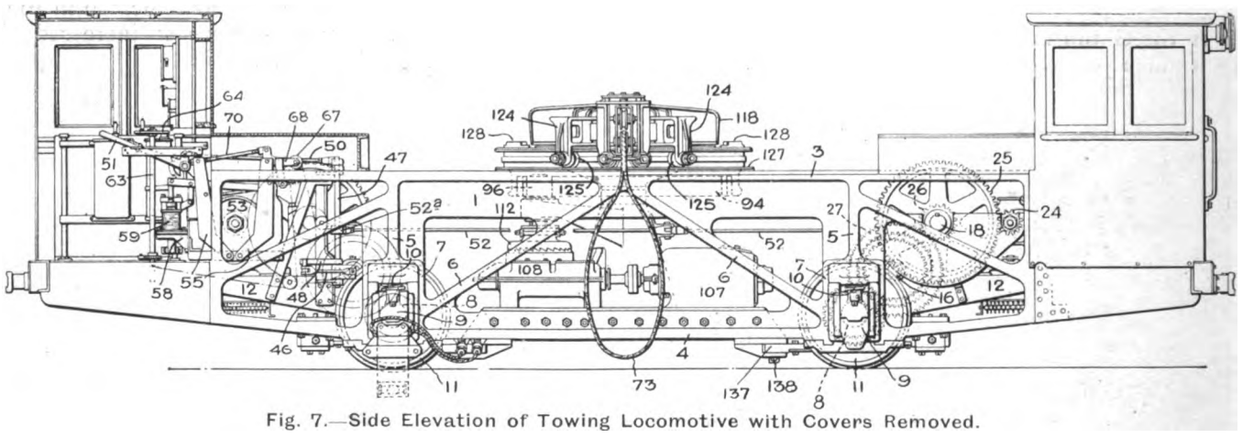

Fig. 7.—Side Elevation of Towing Locomotive with Covers Removed.

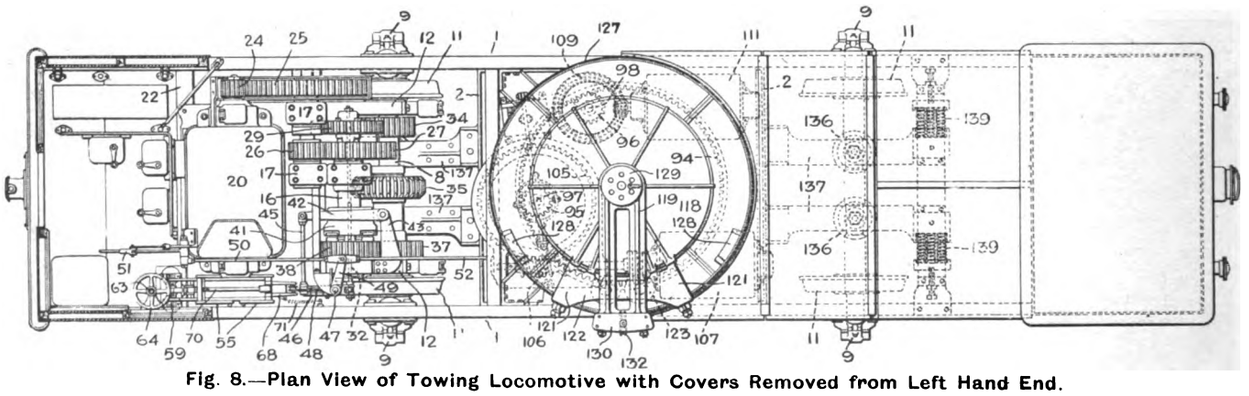

Fig. 8.—Plan View of Towing Locomotive with Covers Removed from Left Hand End.

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an excessive pull on the tow line. These thrust wheels serve to counteract the lateral component of the tow line pull; the flanges act for emergency only, as the weight of the locomotive is sufficient to prevent overturning with a normal pull of 25,000 pounds on the tow line.

Three-phase, 25-cycle, 220-volt, alternating current is used for operating the locomotives, and the current is supplied to them through an underground contact system. The collecting device is illustrated in Fig. 6, while Fig. 9 shows its position with respect to the track, it being next to the outside running rail. Two T rails (shown in black section) form two legs of the three-phase circuit, and the third leg is formed by the main track rails. A specially-designed contact plough slides between the two "T" conductors, and transmits the power from the rails to the locomotive. This contact plough also passes through the slot opening in the conduit cover, and is flexibly connected to the locomotive in such a manner as to follow all irregularities in the tracks and cross-overs. It therefore insures a continuous supply of power.

The locomotives weigh 38½ tons, and were brought from New York as deck cargoes. The working parts of these engines are supported by two longitudinal upright side frames of cast steel (1, Fig. 7) connected by transverse beams (2, Fig. 8). These frames are in effect deep rigid trusses, having upper and lower members connected by posts (5) and diagonal braces (6, Fig. 7). The middle portion of each frame has its upper and lower members parallel and horizontal, but the end portions have their lower members inclined upwardly towards the ends of the frame. The pedestals (7) for the wheel axles (8) are placed at the junction of these end portions with the middle portion. They are of the usual locomotive type, having vertical parallel jaws between which the journal (9) slides. Springs (10) are interposed between the tops of the journal boxes and the tops of the pedestals, and the locomotive is thus mounted upon four wheels (11)

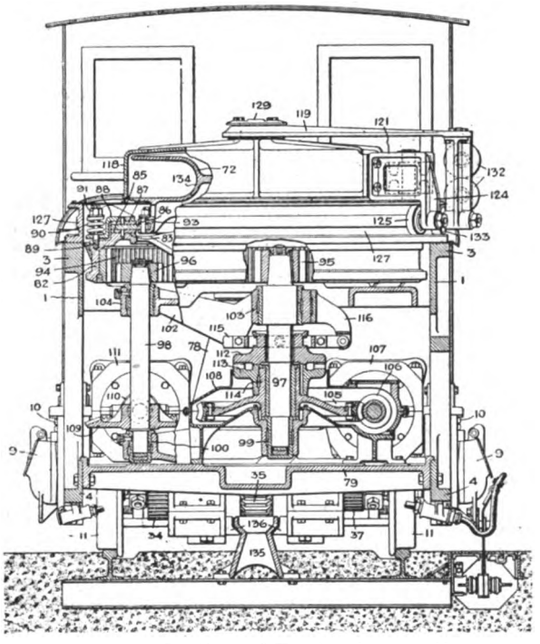

Fig. 9.—Cross Section of Towing Locomotive near the Winding Drum.

carried on the two axles (8), the wheel-base being 12 ft., and the overall length of the locomotive more than 32 ft. Each axle is driven by its own motor, independent of the other and, as the construction is identical at both ends of the machine, a description of one will suffice for both. A cast-steel suspension bracket (12, Fig. 10) is hinged at one end on the axle. Its bearings (13), which fit the journals on the axle, are secured in place by caps (14), which are provided with oil cellars (15). On the bracket bearings are fixed for a transverse jack shaft (16) parallel to the axle, and it has pillow blocks (17) for a countershaft (18) also parallel to the axle. It has a

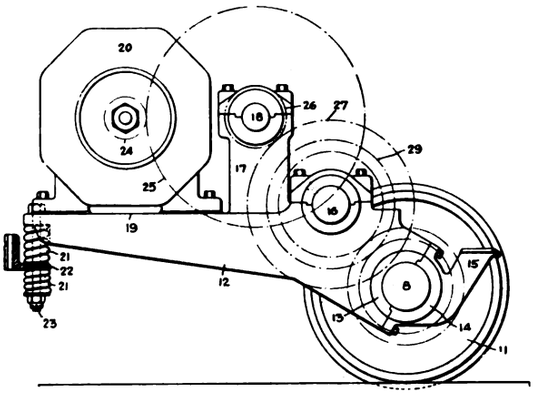

Fig. 10.—Side Elevation of the Traction Brackets.

substantial horizontal platform (19) to support the driving motor (20), and its outer end is borne at each corner by two springs (21) placed above and below a stationary angle iron (22), and connected to the bracket by a bolt (23), so as to afford a yielding support in both upward and downward movements of the bracket.

The motor (20) is of the three-phase, slip-ring type, enclosed; it is geared by a pinion (24) and spur gear

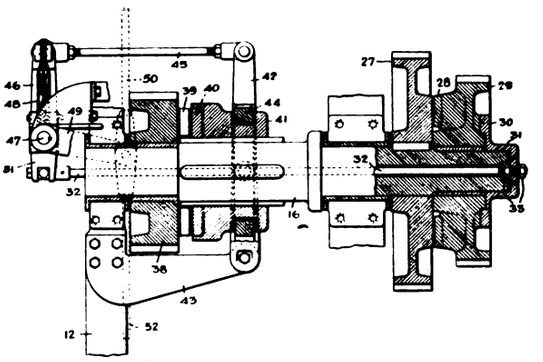

Fig 11.—Sectional Plan of a Check Shaft.

(25) to the countershaft (18), which carries a pinion (26) meshing with a spur gear (27, Fig. 11) keyed to the jack shaft (16). On the outer side of the spur gear (27) are formed clutch teeth which co-operate with similar teeth (28) on the adjacent side of a gear (29), which is sleeved upon the jack shaft and can be slid lengthwise thereon to engage and disengage the clutch teeth. The means for sliding this gear consists of a disc (30) secured to the gear, and having a central hub (31) fitting over the end of the jack shaft (Fig. 11). A rod (32, Fig. 11) runs through a central hole in the shaft and through the centre of the hub (31), to which it is connected by the nuts (33) in such a manner as to permit the disc to rotate with the wheel and, at the same time, cause it to slide the wheel axially when the rod is reciprocated. A pinion (34, Fig. 13) is keyed to the axle (8), and is wide enough to mesh always with the gear (29), so that when the clutch teeth (28) are engaged the motor will propel the locomotive by the adhesion between the wheels (11) and the rails of the

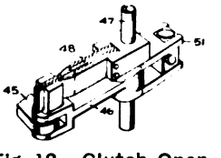

Fig. 12.—Clutch Operating Mechanism.

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track, and this only when running without load and between inclines.

When the locomotive, however, reaches one of the inclines between the locks, the grade of which may be as much as 1 in 2·3, or when it is towing a ship, the cog-rail system is utilised to enable the locomotive to climb the grade and exert the traction necessary for pulling large ships. The cog or rack rail is laid between the track rails, and the locomotive is provided with a cog wheel or rack pinion (35, Fig. 13) secured to or

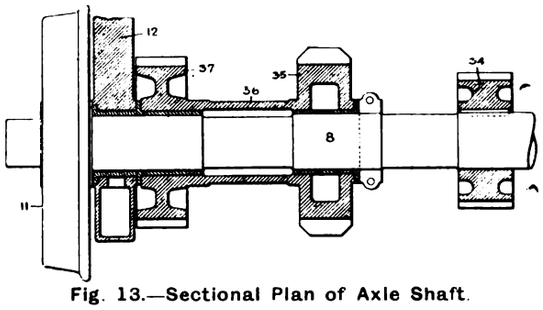

Fig. 13.—Sectional Plan of Axle Shaft.

integral with a sleeve (36) which rotates freely on the axle. A gear wheel (37), secured to or integral with this sleeve, meshes with a gear (38, Fig. 11) turning loosely on the jack shaft. Clutch teeth (39) on this gear can be engaged by the teeth (40) on a clutch (41) which is splined to a jack shaft. A two-armed lever (42), fulcrumed on a bracket (43), straddles the shaft (16), and is pivoted to a collar (44) riding in a groove in the clutch (41). The lever is connected by a link (45) with one end of a lever (46, Fig. 11) turning loosely on a vertical rock shaft (47). An elastic arm is keyed to the shaft and engages lugs on the lever (46). The arm is composed of a laminated flat steel spring (48, Fig. 12), and a second arm (49) is keyed on to the shaft and connected by a rod (50) with a handle in the cab of the locomotive. The handle can be locked by a suitable latch and notched quadrant, and the other end

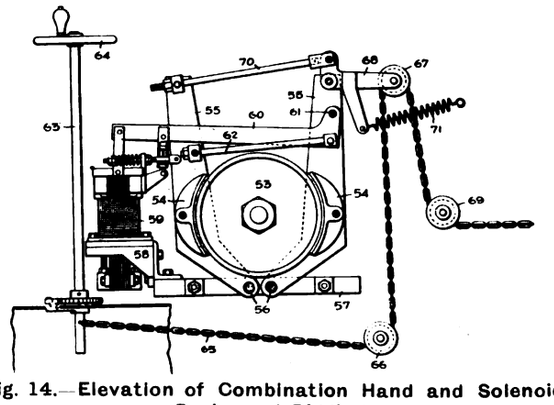

Fig. 14.—Elevation of Combination Hand and Solenoid Brake and Rigging.

of the lever (46) is pivoted to the rod (32) so as to throw out the clutch (28) when the clutch (40) is thrown in, and *vice versa*.

The elastic arm (48) serves to throw the clutches automatically, it being understood that the four jaw clutches in most cases do not mesh when thrown, but that the operating handle is thrown full stroke and locked. This puts the springs under heavy tension. The locomotive is then started slowly; and when the clutches are in alignment the springs throw them without any attention from the operator. The two rocker shafts at opposite ends of the locomotives are connected by rods (52, Fig. 7) pivoted to the rocking arms (52a) on the shafts and to an intermediate lever (52b) fulcrumed on the pedestal supporting the winding drum. Figs. 12 and 15 will be of assistance in making clear the foregoing description of the clutches and gear. The two traction motors have suitable controllers installed in the cabs at the ends of the locomotives; and the circuits are such that both motors can be controlled from either cab, and can be operated singly or in multiple as desired. It will be observed that each motor, with all its gearing and clutches, is mounted

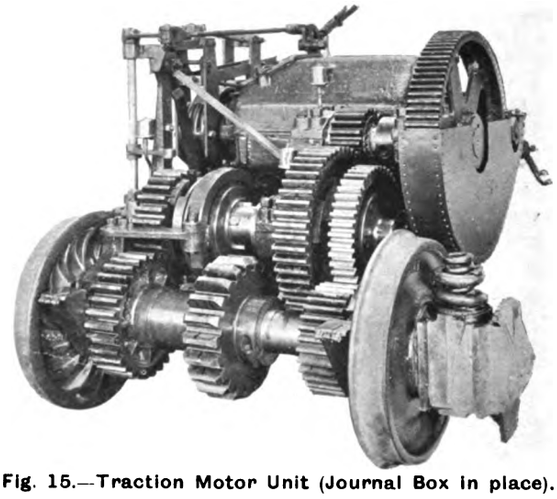

Fig. 15.—Traction Motor Unit (Journal Box in place).

independently of the frame of the locomotive, to which it is connected only by the springs (21), which give an elastic support for the outer end of the bracket (12) on which the mechanism is carried, as shown in Fig. 10. In connection with each motor a powerful brake is installed and, as during operation the motors are at all times geared either to the axles or to the cog wheels, the truck wheels are not provided with any brake rigging. The motor brake is shown in Figs. 11 and 12, but it is more clearly illustrated in Figs. 14 and 20. On the motor shaft is keyed a brake disc or drum (53, Fig. 14), and to opposite sides thereof are applied the brake

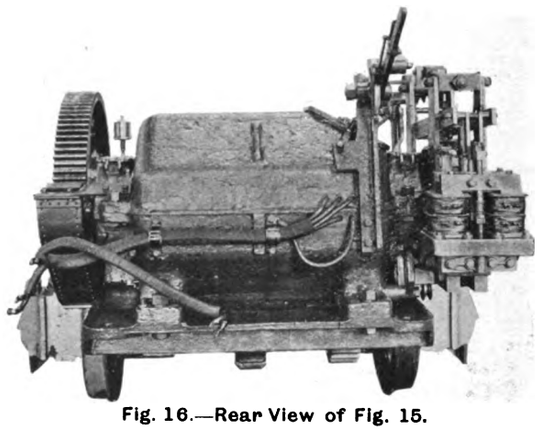

Fig. 16.—Rear View of Fig. 15.

shoes (54), carried by brake levers (55), which are pivoted (56) on a stationary bar (57) projecting from the frame (58) which supports a solenoid (59). The movable core of this solenoid is pivoted to the long arm of the lever (60), which is fulcrumed (61) on one of the brake levers. A rod (62) connects the angle of this lever with the other brake lever, thus constituting a sort of toggle between the two. When the core of the solenoid drops, it actuates the lever and the rod in such a manner as to draw the two brake levers towards each other, thereby applying the brake shoes to the drum. The winding of the solenoid is in circuit with the controller of the motors, so that when the current is turned on to energise the motor windings, the solenoid will lift its core and thereby release the brakes. The first

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point of the controller raises the brakes without applying power to the motors, thereby providing a coasting point. But should the motor current be shut off, either intentionally or accidentally, the core will instantly drop by gravity, and its weight will exert a powerful leverage upon the brake levers and stop the motor and the locomotive. This action occurs simultaneously on both motors, the brake action being powerful enough to stop the locomotive within two revolutions of the wheels.

In addition to this automatic brake, means are provided for applying the brakes manually in order to supplement the action of the automatic feature, if necessary, when descending a grade or where approaching a rack rail. An upright shaft (63, Fig. 14),

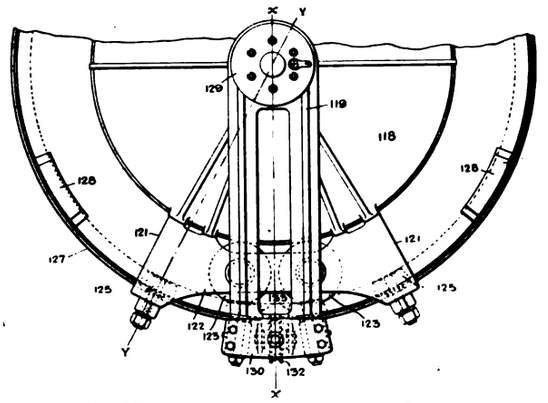

Fig. 17.—Plan of Cable-Guiding Device.

provided with a hand wheel (64), has attached to it one end of a chain (65) which runs under a stationary pulley (66), up over a pulley (67) on one end of an elbow lever (68) pivoted to one of the brake levers, and thence under a stationary pulley (69) to the opposite end of the locomotive. The elbow lever (68) has its other arm connected by a rod (70) to the other brake lever, the rod being adjustable in length as shown. The lever (68) and the rod (70) constitute toggle connecting the brake levers. A spring (71) tends to lift the arm carrying the pulley (67) and thus hold off the brake shoes. When the brake staff is turned it winds up the chain and draws down the pulley (67),

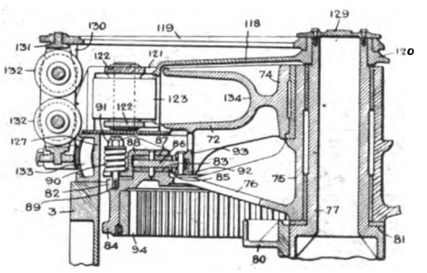

Fig. 18.—Section on X X Fig. 17.

thereby applying the brake shoes to the drum. In this way the operator can add hand power to the effect of the electric brake, and thus produce a greater braking action without interfering with the automatic operation of the solenoid.

As appears from Fig. 8, the brake levers (55) are double, only the rear member of each being shown in Fig. 14. This avoids any bending strains on the pivots. The levers (60 and 68) and the rods (62 and 70), constituting the two toggle systems, are placed between the two members of each lever, as are also the brake shoes (54). The chain (65) extends from the pulley (69) to the similar point in the brake rigging of the motor at the other end of the locomotive, so that the operation of either of the brake staffs will apply both brakes simultaneously. It will be noted that while the hand and solenoid brake mechanism operate entirely independently of each other, both apply braking through the same levers and wheel.

The features which render the locomotive peculiarly adapted for towing purposes are as follow: The drum (72, Fig. 19) on which the cable (73, Fig. 7) is wound

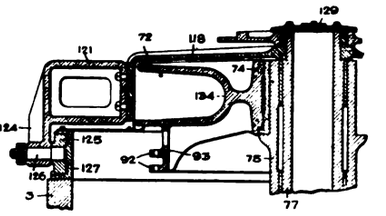

Fig. 19.—Section on Y Y Fig. 17.

is situated midway between the ends of the locomotive and above the upper member (3, Fig. 7) of the side frames, so that the cable can be led off on either side of the machine and through a wide range of angles to the line of travel. The hub (74, Fig. 18) of the drum

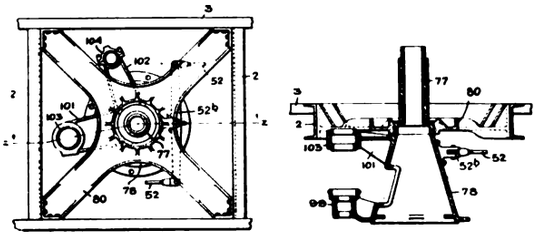

Fig. 20.—Plan and Section on Z Z of Pedestal.

is pivoted to the hub (75) of a spider (76), which in turn rotates upon the upper portion of a massive, tubular, vertical, cylindrical column (77) rising from a pedestal (78, Fig. 20) secured to the base plate or floor (79, Fig. 9), which is supported on the lower members (4) of the side frames. The upper portion of the pedestal is held in a brace (80, Fig. 20) which is shown

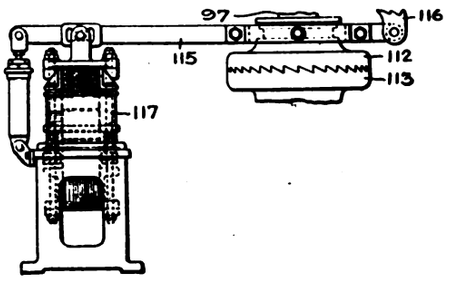

Fig. 21.—Slow-speed Winding Clutch.

as a heavy X-shaped casting, fastened to the upper members (3) of the side frames and to two of the cross beams (2). This brace fits the pedestal just below the shoulder (81, Fig. 18) on which the hub (75) is stepped. The spider (76, Fig. 18) supports a circular rim (82), which has a horizontal upper surface (83) and a flange (84). On the surface (83) is secured a flat, smooth, bronze ring (85), and a second brass ring (87), similar to the first, lies on top of a steel ring and is secured to a flanged follower (88). Sixteen studs (89) project up from the rim through holes in a horizontal flange of the follower and are encircled by strong springs (90), which abut between the flange and nuts (91) on the studs and press all three rings tightly together. The steel ring (86) is secured to lugs (92) on a flange (93) projecting downward from the winding drum (72), so that the rings constitute a friction clutch

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between the spider and the drum. Inside the flange (84) on the spider is secured a large internal gear (94), with which mesh two driving pinions (95 and 96, Fig. 9), secured respectively to two upright shafts (97 and 98). Step bearings (99 and 100) are provided for these shafts in the base of the pedestal (78, Fig. 9), while the arms (101 and 102, Fig. 9), projecting from the upper portion of the pedestal just below the brace (80, Fig. 9), constitute guide bearings (103 and 104) for the upper portions of the vertical shafts. A worm gear (105, Fig. 9) is clutched to the shaft (97), and is driven by a worm (106) on the shaft of an electric motor (107) bolted to the base (79) of the locomotive. This gearing is protected by a casing (108). A bevel gear (109) is keyed to the upright shaft (98), and meshes with a bevel pinion (110) on the shaft of an electric motor (111) fastened to the base. The motor (111) with bevel gear pinion is used for driving the drum at a high speed when coiling the cable that has been cast off, and it remains permanently in gear. The other motor (107) with worm gear drive is used for taking in the cable when it is under load, and the drum operates as a windlass or capstan. Owing to the greater gear reduction it operates the drum at a much slower speed and, consequently, with motors of approximately equal size, a greater force may be exerted on the tow line than would be possible with the lower speed reduction. The worm gear drive is disconnected from the drum when not in use. To accomplish this a clutch is provided, having one member (112, Fig. 9) splined to the shaft and the other member (113) attached to the hub (114) of the worm gear, which is sleeved on the shaft.

A lever (115, Fig. 21), fulcrumed to a lug (116) on the arm (101), is pivoted to the hub of the clutch member (112), and its other end is attached to the movable core of a solenoid (117) which is connected in the controller circuit of the motor (111), so that whenever the circuit of the latter is closed, to coil up the cable rapidly, the solenoid will lift its core and also the lever (115), thus throwing out the clutch of the winding motor. The first point of the controller which operates the motor (111) raises the clutch, and on the second point the motor starts.

parallel bars (122, Fig. 17), one above and the other below the opening. Between the bars and on either side of the opening are two upright guide rolls (123, Figs. 17 and 18) having cylindrical faces and rotating on journals bearing on the bars (122). At each end of this frame, arms (124, Fig. 19) extend downward and support two rollers (125, Fig. 19) mounted on horizontal studs (126, Fig. 19) secured in the arms. These

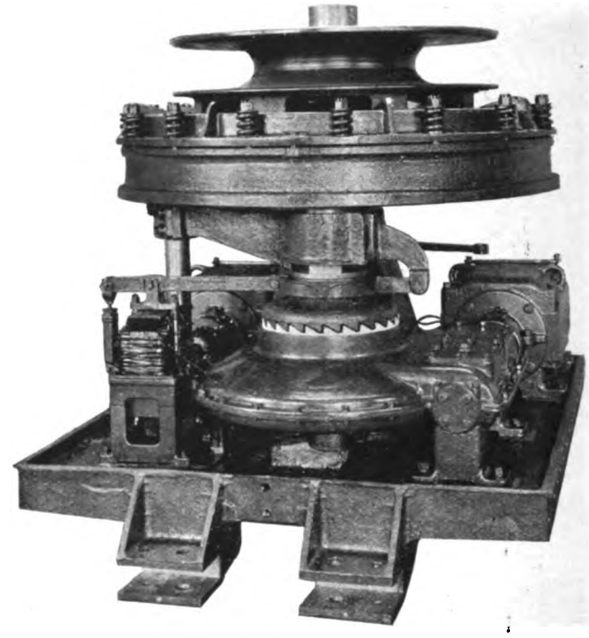

Fig. 22.—Windlass and its Base.

rollers are adapted to travel between the upper and lower flanges of a circular channel iron (127), which is fastened on top of the side frames concentric with the column (77), and forms a track supporting the outer end of the frame (121 and 122), thus relieving the column (77) of the weight thereof. Stops (128, Fig. 18) are fastened to the top of the channel iron (127) to limit the angular play of the guide member (118). They can readily be taken off, and the housing can be turned

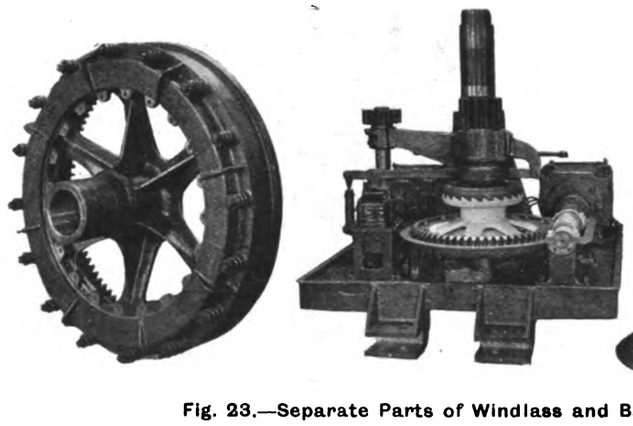

Fig. 23.—Separate Parts of Windlass and Base.

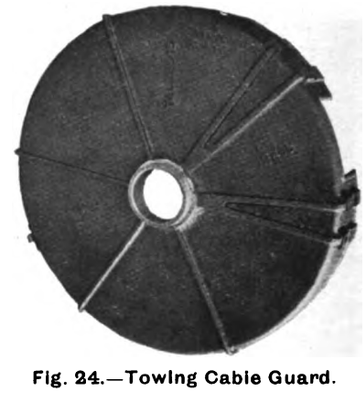

Fig. 24.—Towing Cable Guard.

The guide which directs the cable, as it pays out or winds up, is mounted so as to revolve on the axis of the drum. It comprises two angularly adjustable portions (118 and 119, Figs. 17 and 18), the former being a circular bell, which serves as a cover for the winding drum. The hub (120, Fig. 18) of the bell is journalled on the upper end of the column (77), being stepped on a shoulder thereon. At one side the housing is cut away to admit the cable to the drum, and on each side of this opening is bolted one end of a frame comprising box-like ends (121, Figs. 17 and 18), connected by two

until the rollers (123) are on the opposite side of the locomotive, after which the stops can be attached on that side to limit the movement of the housing.

The other guide member (119) is a radial casting having one end turning freely on the hub of the member (118, Figs. 9 and 17). A cap (129, Fig. 17) is provided at the top of the column (77, Fig. 20), protects the joint, and prevents the guide members from accidentally coming off. The outer end of the member is an upright rectangular frame (130), in whose top and bottom is journalled on a vertical axis a swivel (131, Fig. 18) carrying

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two grooved sheaves (132), these also being led one above the other on horizontal axes. The edges of these sheaves are in close contact, so that their grooves form an opening through which the cable passes, approximately, in line with the middle of the guide

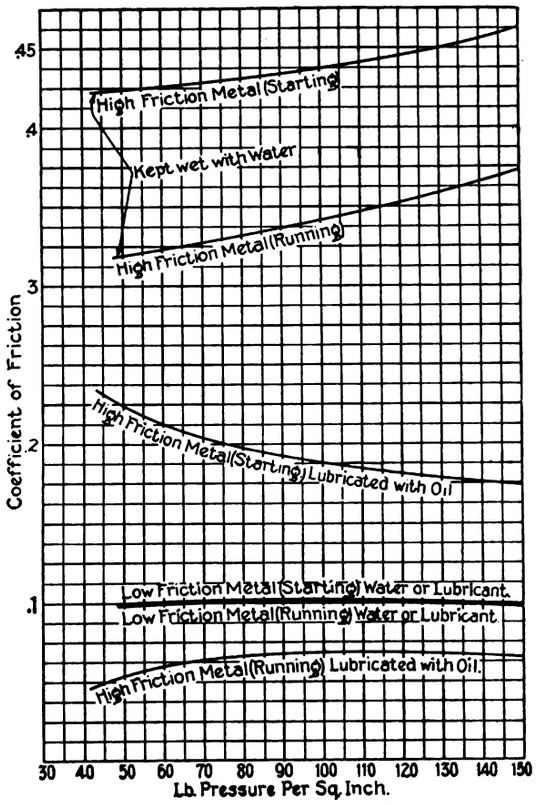
Coefficient of Friction
.45
.4
.3
.2
.1
High Friction Metal (Starting) Kept wet with Water
High Friction Metal (Running)
High Friction Metal (Starting) Lubricated with Oil
Low Friction Metal (Starting) Water or Lubricant
Low Friction Metal (Running) Water or Lubricant
High Friction Metal (Running) Lubricated with Oil
30 40 50 60 70 80 90 100 110 120 130 140 150
Lb. Pressure Per Sq. Inch.

Fig. 25.—The Result of Tests to Determine the Proper Friction Metal.

rollers (123). The frame (130) is supported by rollers (133, Fig. 18) running in the track (127, Fig. 17), and the guide member has an angular movement with reference to the member (118) limited by the frame (130) striking the ends of the frame (121). When the cable is pulled

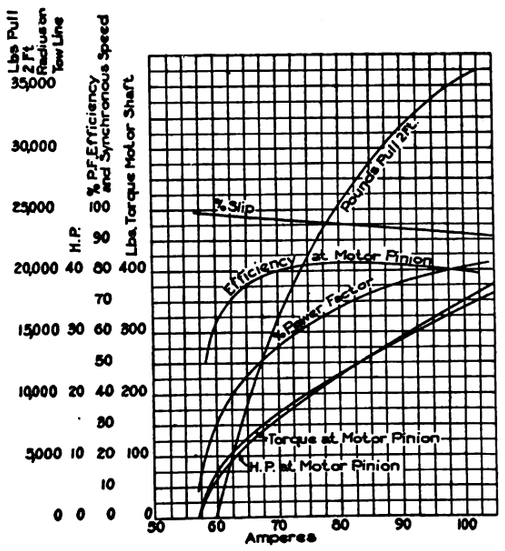

Fig. 26.—Characteristics of the Windlass Motors.

either forward or backward from the middle position which it occupies in Fig. 7, the swivel permits the grooved rollers (132, Fig. 18) to move with it, and the guide member (119) swings also, so that the rollers (132) continue to support the rope in a line with the middle of the rollers (123), without being themselves subjected to any side strain. All lateral strains are sustained by these heavy guide rollers (123), the cable moving up and down between them as it winds on the drum. The latter is in the form of a deeply-grooved

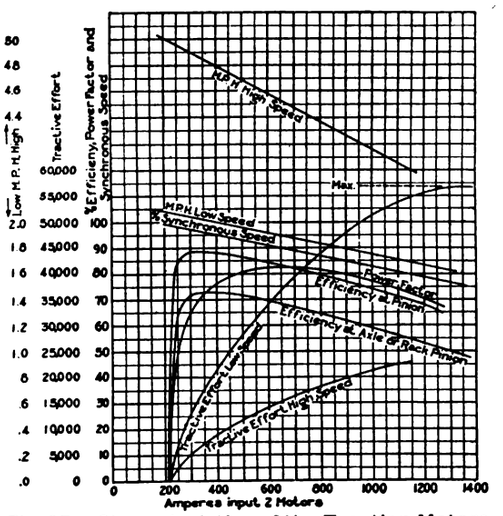
Low H.P. Ht. High
Tractive Effort
% E. Efficiency, Power Factor and Synchronous Speed
Kept at High Speed
Max.
MPH Low Speed % Synchronous Speed
Power Factor
Efficiency at Pinion
Efficiency at Axle of Rack Pinion
Tractive Effort Low Speed
Tractive Effort High Speed
0 200 400 600 800 1000 1200 1400
Amperes input 2 Motors

Fig. 27.—Characteristics of the Traction Motors.

wheel, the groove (134) being U-shaped. Figs. 22, 23, and 24 clearly illustrate the construction.

Fig. 24 shows the cable guard. This is a steel

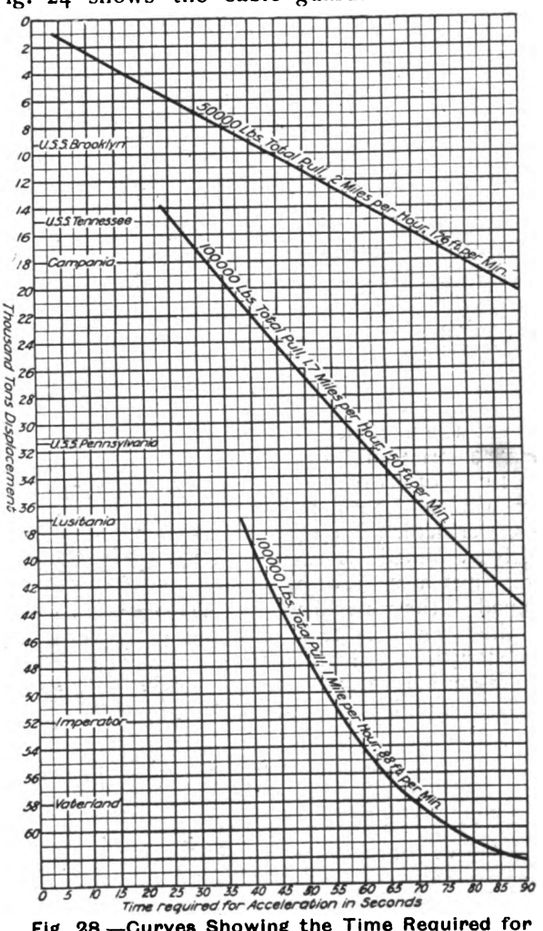
Thousand Tons Displacement
U.S.S. Brooklyn
U.S.S. Tennessee
Campania
U.S.S. Pennsylvania
Lusitania
Imperator
Vaterland
500000 Lbs. Total Pull, 2 Miles per Hour, 176 ft per Min.
100000 Lbs. Total Pull, 1½ Miles per Hour, 150 ft per Min.
100000 Lbs. Total Pull, 1 Mile per Hour, 88 ft per Min.
Time required for Acceleration in Seconds

Fig. 28.—Curves Showing the Time Required for Acceleration of Ships.

casting having a thickness of only $\frac{3}{8}$ in. The diameter is 4 ft. 6 in. and the circular flange 17 in. deep. This casting was pronounced by some to be beyond the possibilities of the ordinary open-hearth furnace. The castings were, however, produced in the contractor's

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electric furnace, in which the heat can be intensified so as to make the metal flow more rapidly: no failures occurred. With the exception noted, all other principal steel castings for these locomotives were produced at the plant of the Wheeling Mold and Foundry Company, Wheeling, W. Va.

In order to resist the tendency of the locomotive to tip over when an excessive load comes on the cable a

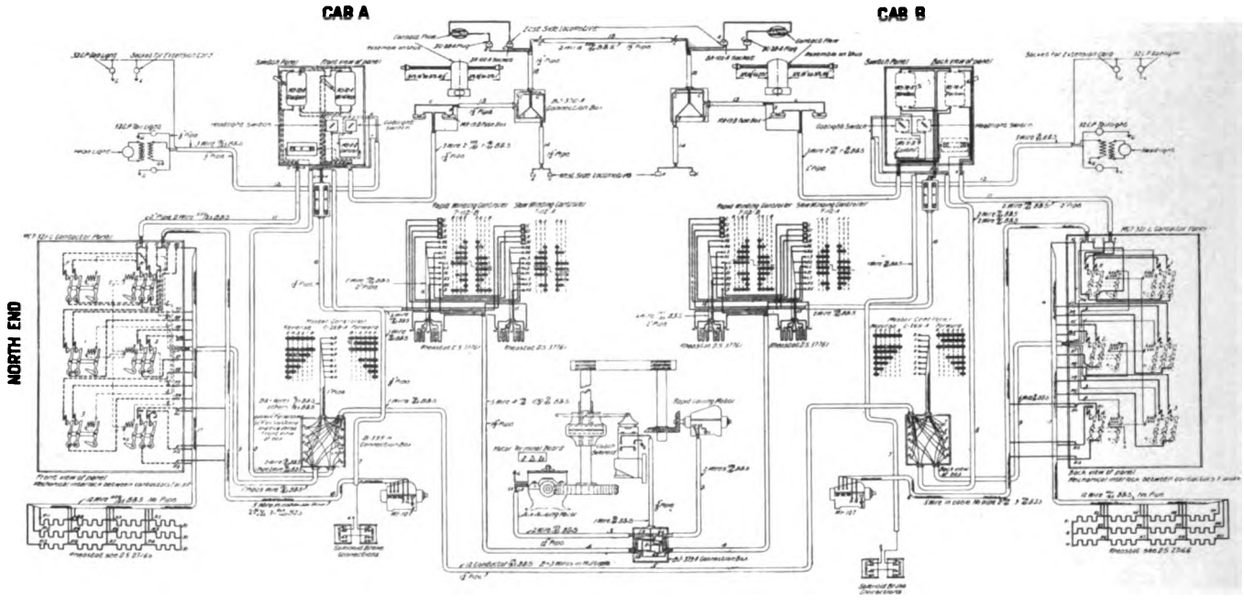

Fig. 29.—Wiring Diagram of the Electric Connections on the Towing Locomotives.

stout rack rail (135, Fig. 9) is laid between the traction rails of the track, and two horizontal flanged wheels (136) are arranged between each pair of wheels (11) to engage the opposite sides of the rack. These wheels are carried on heavy bars (137) whose inner ends are pivoted (138, Fig. 11) to the base of the machine, so that the bars can move horizontally. Their outer ends are engaged by strong springs (139) which afford the necessary flexibility for smooth operation.

One of the most important parts of the locomotive is the "slip-friction" device consisting of two special alloy rings, mounted on the spider, as has been previously explained. Between these rings a steel disc is fastened to the rope drum; and the amount of tension on the tow line is adjusted by the pressure between these three discs, and is obtained by tightening the spiral springs on the clamping ring. In order, therefore, to make the slipping tension of the tow line proportional to the pressure between the friction discs, a rubbing surface having an absolutely constant coefficient of friction is essential. The tests made to find such a metal are shown by curves in Fig. 25, which is self-explanatory. The low-friction metal, having a friction coefficient of 0·1, is practically constant under all pressures and condition of the surfaces, and therefore was selected for the work. This metal also showed but very little difference in coefficient between starting and running. The results of the special tests were furthermore amply verified by the final test of the friction discs of each machine under full rated tow line pull of 25,000 lb. by means of a dynamometer testing outfit. All 40 machines were given this slip test 25 times from each cab, and all passed the Government requirement not to exceed a variation of 5 per cent. above or below the normal of of 25,000 lb.

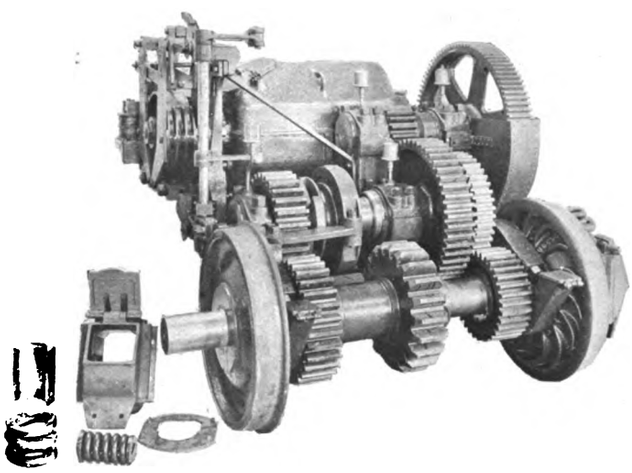

Fig. 30.—Traction Motor with Journal Box Separated.

In connection with the slip test, further data on the slow-winding motor was obtained as per curves in Fig. 26. The winding motor is a 20-H.P. (one hour rating), three-phase, high torque, squirrel-cage type, induction motor, controlled from a drum type reversible controller in either of the two cabs. From the curves it is seen that the motor has ample power to take care of any sudden pull on the tow line up to 40,000 lb., which is well above the normal requirement of 25,000 lb. The speed of winding is at the average rate of 12 ft. per minute.

The rapid-coiling motor is permanently geared to the drum, and is of the same type, size, and capacity as the winding motor. It is subjected to its maximum load when accelerating the heavy drum to the high speed required for coiling or paying out the rope, this being 16 times the slow-winding speed at full load, or about 200 ft. per minute.

The slow-winding and the rapid-coiling motors are operated by similar controllers, and the circuits electrically interlocked so as to prohibit application of power to either motor unless the controller of the other motor is in the "off" position.

Each of the two main traction motors has a rating of 75 H.P., and is of the slip-ring induction type, operated by a system of contactors, with master controller in each cab. The motors, by means of the change in gearing from straight traction to rack rail towing previously described, drive the locomotive at a speed of

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two miles per hour when towing and five miles per hour when returning idle. These motors act as induction generators running above synchronous speed when the locomotive is passing down the steep inclines and thereby exert a retarding brake effect to keep the speed uniform. Speed tractive effort and efficiency tests were made with results as per the curves in Fig. 27.

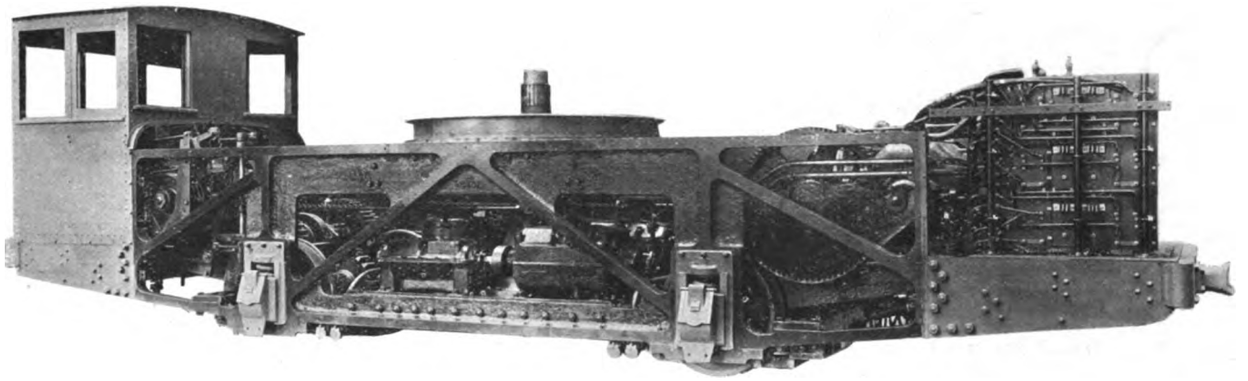

Fig. 31.—Towing Locomotive with Covers and One Cab Removed—Showing the Back of a Control Panel.

The curves in Fig. 28 give some interesting data on the time of acceleration of ships in the lock chambers. These values have been obtained from certain tests and theoretical calculations based on data given by several well-known authorities.

Space does not permit of a detailed description of the locomotive control apparatus, but a fairly good idea will be had by reference to the diagram of connections shown in Fig. 29.

The first impression might be that these machines are somewhat complicated, but, considering their many functions and the great flexibility for performing them,

Fig. 32.—Towing Locomotive on Test Track.

the design is in reality peculiarly simple. The locomotives have fully demonstrated in actual operation that the requirements contemplated by the engineers of the Isthmian Canal Commission have been successfully met.

During the first three months of commercial operations, from August 15 to November 15, the cargo transported through the canal and towed through the locks by the locomotives amounted to 1,079,521 tons. During the fiscal year ending June 30, 1914, the Panama railroad carried 643,178, or 164,795 tons a quarter, of through freight between the two seaboards, and in the preceding fiscal year 594,040, or 148,510 tons a quarter. From this it is seen that between six and seven times as much cargo is passing over the isthmus now as passed over this route when goods were transhipped by rail.

Free Rides for Men in Uniform.—Tramway authorities all over the country have been carrying men in uniform at all times free of charge. It is evident that the cost of the arrangement has been much higher than anyone bargained for. No one anticipated that the war would attain the colossal proportions it has assumed, and carrying free passengers costs money that many undertakings cannot afford to lose. It might be advisable, therefore, to restrict, as gently as may be, a privilege accorded under exceptional circumstances.

CENTRE v. SIDE-SLOT CONDUIT SYSTEMS.

The London County Council have decided to substitute the centre for the side-slot system on the tramways from Shoreditch to Stamford Hill. These were reconstructed for electric traction in 1906, and, as an experiment, about a mile of double line was laid on the side-slot underground conduit system, in order that a comparison might be made between this system and the standard centre-slot system. It has been observed that, owing to the wear of the rails forming the conduit slot, the width of the slot has increased, while as compared with the centre slot, the renewal of the running rails which form one side of the slot has to be undertaken at an earlier date, and four times as much street rubbish accumulates in the conduit. Moreover, it has been necessary to equip cars that operate over the side-slot system with special plough carriers, and in the event of arrangements being entered into with the Metropolitan Electric Tramways, Limited, for through running along Kingsland Road, it would be necessary to equip the company's cars with special plough-carrying equipments. Breakdowns have been frequent at the points where the slots diverge from the side to the centre of the track and *vice versa*. It is estimated that the work will cost £12,500, and it will be carried out in connection with rail-renewals, and spread over a period of five years.

MONTREAL AS AN ELECTRIC POWER CENTRE.

The position of Montreal as a centre of electric power generation is dealt with in the annual report of the Montreal "Board of Trade," which says that the situation with respect to the public service corporations of the City of Montreal is becoming of great importance. Montreal is surrounded by a number of water powers the combined capacity of which, after development, has been estimated at not less than 500,000 H.P. Assuming that 40 per cent. of this might be used outside the city, the advantages of that proportion would still be more or less tributary to Montreal, and 300,000 H.P. would remain for the use of industries located in the city itself, and thus at least double the amount of electricity now sold in the city would be available for its use. During the past year the completion of the Cedars Rapids plant has added 100,000 H.P. to the supply, 60 per cent. of which is being sent over to the State of New York, leaving 40 per cent. for Montreal. These facts show that Montreal is one of the greatest natural power centres in the world. In this connection the tramways situation has been arousing much interest; for the company is desirous of obtaining an extension of its franchise.

Record Speed.—At Marylebone Police Court, on February 16, a tramcar driver was fined 40s. for driving at the rate of 30 miles 1,558 yards per hour along Camden Road.

Tramworkers Seek Increased Wages.—The executive of the Amalgamated Society of Tramway and Vehicle Workers at their monthly meeting at Salford unanimously decided to give permission to all branches of the society to apply for an increase in wages to the extent of 15 per cent. The society has a membership of nearly 30,000, and the meeting was attended by representatives from London, Manchester, Birmingham, Leeds, and Wales.

Shipments to Mexico Inadvisable.—From a report received by the Commercial Intelligence Branch of the Board of Trade from a reliable source, states the "Board of Trade Journal," it would appear inadvisable at present to make shipments destined to Mexico City or, indeed, to any interior points of Mexico, as it seems very doubtful if goods could be transported inland owing to the political disturbances and the damage to railway lines.

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LONDON, MARCH 11, 1915.

London Electricity.

Once more London has been baulked of a great comprehensive scheme for putting electricity supply for all purposes on a footing commensurate with the needs of the Metropolitan area. The record of past attempts in this direction, made for the most part by private enterprise, is a long one, and throughout the magnitude of conflicting interests, both municipal and company, has sufficed to prevent anything being done. The great scheme, elaborated by the London County Council after much technical research, promised to be one of the best, if not the very best, ever put forward. The interests of the 70 odd existing municipal and company undertakings would have been sufficiently safeguarded, gradual consolidation would have gone on, a great new bulk supply from an enormous generating station would have been provided, and the benefits of municipal control and company operation would have been combined. A few weeks ago, however, the County Council failed to find a sufficiently large majority of members in favour of the bill, chiefly because so many councillors are absent at the war, so that the measure could not be proceeded with this session. Since then, in the latter days of February, another London electric supply bill came to an end. It was a measure promoted by a number of the metropolitan electric companies for consolidation, and though on a less ambitious scale than the County Council scheme, it was really a competing measure. The Government are anxious that during the war no highly contentious business should be brought forward, and they extend this prohibition even to private bills where the contentious matter is of a public, as distinguished from a minor local, character. The Chairman of Ways and Means of the House of Commons, acting on authority from the House, intimated that he had informed the promoters that in his view this bill raised such issues that it should not be proceeded with at present. This means that no comprehensive London electric supply scheme will be dealt with until after the war is over. Meanwhile the whole London area will have to remain content with a supply which, compared with that obtainable in other large centres, borders almost on the ridiculous. Railway electrification and tramway extension are among the things which are hampered by the absence of an abundant cheap electricity supply over the whole of Greater London and the surrounding district.

Belgian Tramway Enterprise.

There is no country in which electrical railway and tramway enterprise is not affected by the cataclysm which is now devastating a great part of the Continent of Europe. In countries far distant the changes will probably be neither direct nor radical. Initiative may be checked for a time, but organisation and maintenance will continue, no doubt, to be largely unaffected. In Germany, France, and above all in Belgium, however, the transport industry has already undergone enormous changes. At present it is idle to speculate on the way in which recovery will be made after the war, or what will be the ultimate result in accelerating or retarding the rate of progress which during the past 10 or 15 years had steadily increased, and had profoundly influenced the development of Continental countries both industrially and commercially. The influence on the life of the people had been felt among all classes, and in many districts had altered the whole character of business and greatly changed the social habits of the people. It is difficult for those who were unfamiliar a few years ago with localities now well served by electric tramways

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or railways, to conceive how greatly conditions have been altered by the increased facilities for locomotion. In no country in Europe had the change been more thorough than in Belgium. Her tramways and light railways had become a model for other nations. Her capitalists, having acquired unrivalled experience in their own country, had extended their operations not only to other countries but to other continents, and the Belgian capital had become the official headquarters of traction and power corporations whose operations extended throughout the world. In the enterprises controlled from Brussels, Belgian, French, German, and British financiers had made large investments, and, as a whole, the undertakings in which they were concerned were being well and successfully directed. Belgium's position as a neutral country, enjoying as was supposed, the guaranteed protection of her powerful neighbours, encouraged the gathering in her capital of companies operating in various other countries, and Brussels thus came to exercise a powerful influence on tramway progress. It was the birthplace of the International Tramway Union, for many years so admirably directed by Baron Janssen, the head of the Brussels Tramway Company, an undertaking which was the forerunner of many other prosperous systems in Belgium. The conditions of most of these systems under the overwhelming catastrophe of the German occupation can only be described as one of suspended animation. Yet the undertakings are by no means extinct, and as soon as the invader has relaxed his grip there will be rapid recovery; and in much less time than many anticipate Belgian tramway enterprise will resume much of its former activity, but it will, in some respects, present important changes. The close relations with German manufacturers will, for some years at least, disappear, and this will offer to British manufacturers and dealers new and important opportunities of which, it is to be hoped, full advantage will be taken; even at the present time agreements and arrangements could now be made with many Belgian authorities which would become operative at the earliest possible moment. There must be many influential men of both English and Belgian nationality who would be willing to put their heads together and evolve some general scheme advantageous to all.

Replacement of Omnibuses Needed for the War.

If the Birmingham Tramways Committee have the power to purchase ten motor omnibuses to take the place of those impressed by the military authorities, the Tramways Committee of a city like Liverpool ought to be able to adopt a similar course without reference to the Corporation as a body. In each city the municipal authority had sanctioned the original outlay, so that the question to be determined was not one of embarking on a new expenditure. The sums allowed by the War Office representatives are decidedly liberal, the reduction on the purchase price amounting only to the depreciation entailed by usage. Thus, if a local body who have had their vehicles taken for war service have observed the rules of sound finance they should be able to make good the deficiency from the sum set aside on depreciation account. If this course has been adopted the most ardent advocate for the control by the whole Council of the actions of a committee cannot contend that a new outlay is involved in a decision or recommendation to acquire new machines. Viewed from a patriotic standpoint, the refusal of Liverpool Corporation, by 35 votes to 19, to authorise the replacements, does not reflect credit upon the authority. The members were warned by Alderman Smith, the deputy-chairman of the Tramways Committee, that the War Department had intimated that they might require the services of an additional number of the Council's vehicles, a course which will undoubtedly further inconvenience the Tramways Committee and the travelling public if steps are not taken to make good the existing deficiencies. That further impressments will be made is indeed most likely in view of the great task which the two Allied Armies are undertaking in the spring. Although the makers of heavy motors have been engaged during the past six months in turning out thousands of vehicles for the great advance, the further requirements of the War Office are likely still to claim a large share of their attention concurrently with such civil orders as have accumulated since so many public service vehicles and private lorries were impressed for national service. Owners of the former class of conveyance ought long ago to have made up their minds as to the necessity of restoring the services to the

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condition prevailing before the war. Apparently Liverpool is the only instance to the contrary, and a late repentance on the part of the rulers of that city will no doubt entail the punishment of considerable delay before the makers are able to fulfil the order. Meanwhile, Liverpool will be inconvenienced not only upon the routes from which omnibuses have disappeared or been reduced in number, but in the use of the self-contained vehicle for the relief of congestion on tramway routes. Apart from these important considerations, a set back may be given to the proposals which exist in the minds of the Liverpool authorities for the attainment of greater speed by tramcars and omnibuses running on special tracks on wider roads constructed in undeveloped districts. There would have been less ground for criticising the majority of the Corporation if they had agreed to install railless trolley cars in the place of the omnibuses, for the former vehicles not being of any use to the military authorities the change would have satisfied the objection of the Corporation to having their property seized.

A New Branch of Electric Traction.

It is a curious fact that the most urgent business of the Electric Vehicle Committee is to convey some of its enthusiasm to central station engineers and tramway managers. The natural tendency in such quarters should be in favour of any promising application of electrical energy; but the committee represents only a small minority of central stations, and it finds the average user of motor vehicles more responsive than those actually concerned in the production of electricity. The explanation of this anomaly is in part that electrical engineers remember most clearly the past disappointments with accumulator vehicles. Further, the central station or tramway engineer is a confirmed sceptic, trained to demand convincing proof repeated again and again before he will recommend the spending of money on any new scheme. In the case of the electric vehicle, however, electrical engineers should be the first to appreciate the value of the improvements which have been made in the reliability and robustness of storage batteries. These improvements have, as we have said more than once, put quite a new face upon what was lately regarded as an abandoned problem. They are important enough to induce the engineer to keep earlier failures out of the calculation. The tramway engineer has now, in addition to the general arguments for accumulator traction in special cases, the experience of pioneers in more than one country to go upon. In this country, results obtained at South Shields and Southend go to prove that in certain circumstances tramway engineers may congratulate themselves upon their enterprise in adopting a mode of transport which, in the present popularity of petrol, is unfashionable. Perhaps the wholesale commandeering of petrol vehicles will induce the tramway manager to give more sympathetic consideration to a movement which is essentially an expression of faith in electric traction. In any case the situation is one in which an open mind may be strongly recommended.

RULE OF THE ROAD.

The Wolverhampton borough coroner, Mr. G. M. Martin, gave a lucid exposition of the rule of the road for motors and other vehicles passing tramcars, in regard to which there seems to much confusion in the public mind. The occasion was an inquiry into the circumstances of the death of a schoolboy, which resulted from injuries caused by a taxi-cab knocking him down.

Before taking evidence, the coroner pointed out to the jury that the question of the driver of the motor car being on the right-hand side of the tramcar did not now arise so far as the liability of the driver was concerned. Some time ago there was a rule under the Motor Cars Order by which a driver of a motor car travelling in the same direction as a tramcar was bound to pass the tramcar on the right off side. On January 12, 1909, a case was heard in which it was held according to rule that a driver who had passed a tramcar on the left (or near side) had committed an offence, quite apart from any danger to the public. The Lord Chief Justice observed that this seemed to be very extraordinary and ought to be altered. A new order was therefore issued the following April rescinding the existing order, so that a driver now was under no restriction one way or the other. If a motor car was following a tramcar the driver was not bound to go to the left or the right, but on whichever side the traffic allowed. This, of course, was subject to the driver being careful that he did not run into anyone. That was the position at present. He apprehended that in this case the question for the jury was whether the driver exercised due care.

The evidence showed that a hand cart and a group of children were between the pavement and the tramcar, and the taxi-cab driver was compelled to go round the off side of the tramcar to pass it. The boy at that moment ran into the street, though the driver kept constantly sounding his hooter. In the opinion of the coroner the accident was unavoidable, and the jury returned a verdict of accidental death.

The Tramway Men's Demands.—The Executive of the Amalgamated Association of Tramway and Vehicle Workers give the following reasons for their demand of 15 per cent. increase in wages: The members feel compelled to take this course in order to ensure that they and their families may be maintained in a state of physical efficiency. The Board of Trade figures show that since 1905 the purchasing power of a sovereign has declined from 20s. to 12s. 3d., and although advances of wages have been made, the advance in all has not equalled the rise in the prices of commodities. Since the war commenced, we have suffered what is equivalent to a reduction of 7s. 6d. per week on a wage of 30s. In most places, services have been reduced and running speeded up to such an extent that employers have been earning 25 per cent. more than they were in July, 1914.

Trailer Cars for London.—The new trailer cars ordered by the London County Council Tramways are to be delivered in April, and will then be put in service on the Tooting, Streatham, Battersea, New Cross, and Eltham routes.

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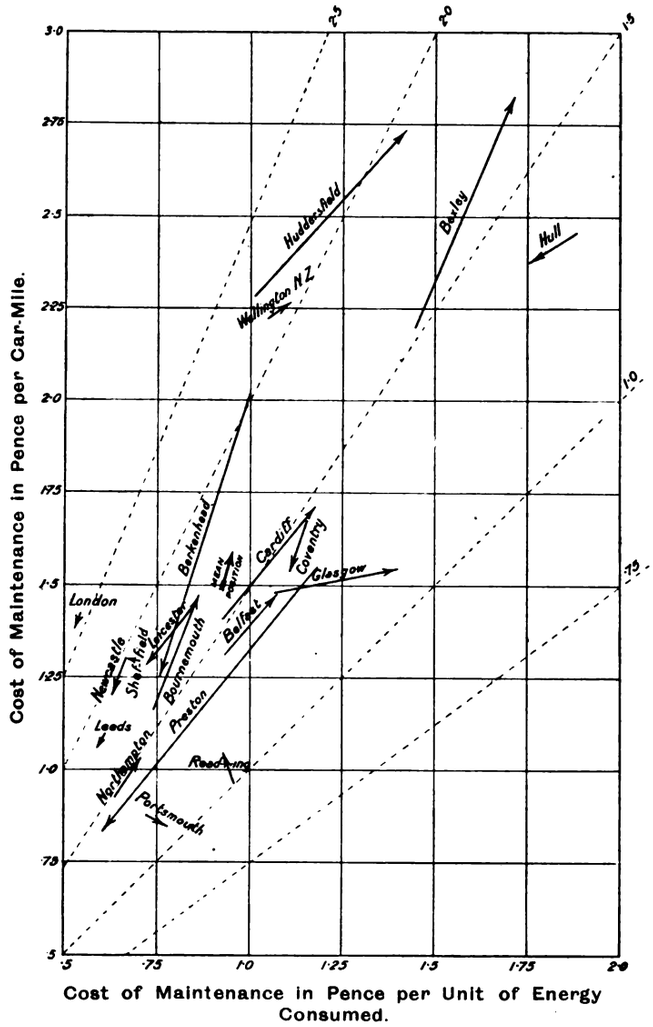
THE COST OF MAINTENANCE PER CAR-MILE AND PER BOARD OF TRADE UNIT.

An article and diagram dealing with the cost of maintenance and energy consumption per Board of Trade unit appeared in our issue of January 14 last. In that number the discussion was confined to towns having a combined generating station for traction and lighting. Those having a separate generating station for traction purposes are now considered. Referring to the diagram, it will be seen that the cost of maintenance per car-mile is measured vertically in pence according to figures given on the left-hand side, while the cost of maintenance per unit, also in pence, is measured horizontally according to figures given on the lower edge of the diagram. In addition, there are



dotted lines crossing the diagram diagonally which give the current consumed per car-mile according to figures to be found on the upper and right-hand edge. The position for each town is marked by an arrow, of which the point defines that for the last year of which the accounts are available, and the head that for the next previous year. The former is in most cases the year ending on March 31, 1914, but for Leicester the year ends on December 31. Much that was said in the previous article, of the diagram relating to towns having a combined generating station, applies also to this. The disparities are very marked not only between the figures for different towns, but between those for the same town in the two different years. The magnitude of the disparities will perhaps be best appreciated when it is realised that the mean of the total capital expenditure for the towns comprised is about 46 pence per car-mile, or 28 pence per unit of current consumed. Thus an alteration amounting to rather less than ½d. per car-mile or rather more than ¼d. per unit, spent on maintenance, is tantamount to an alteration of 1 per cent. by way of profit, calculated on a fair capitalisation of a tramway undertaking. It is, however, to be mentioned that in computing the mean capital expenditure per car-mile and per unit, London tramways were disregarded, for the reason that being constructed on the conduit system the figures in that case were in no way comparable to those for the other towns. A feature of the present diagram which was not in the last is the introduction of a thick arrow to mark the position which represents the average of the positions occupied by the several towns appearing upon it. This mean position is not that which would result if all the undertakings were combined and their results taken together. In such an arrangement the figures for the smaller towns would be swamped by those of the larger, as for example, Glasgow and London. The mean position here marked is that of the centre of gravity of the points of which it is the mean. Its use is to enable the eye to judge the extent to which the various towns depart from it.

RUSSIA'S IMPORTATION OF TRAMWAY MATERIAL.

All the political economists, industrialists, and trade exporters of Russia are busy studying out means whereby the country's dependence on Germany for many classes of goods may be much restricted, if not entirely obviated. One class of goods in respect to which Germany almost completely controls the Russian market is electrical plant and machinery. Particulars have recently been published showing to what extent Germany holds the leading position compared with other countries, and the great advance that has taken place in the importation of such goods into Russia during the past few years. We find for example that the value of non-insulated copper wire imported rose from £24,000 value in 1906 to £38,000 value in 1913. There was also a great advance in the importation of insulated copper wire of various diameters. On the other hand, there is to be noted a great decline in the importation of electric cables, which fell from £143,000 value in 1906 to £17,400 in 1913. However, 1906 appears to have been an altogether exceptional year for this class of goods, for the next highest to it was 1908 with £48,000 value. But even this, compared with the imports of 1913, shows a remarkable dislocation of business. The fact appears to be that Russia has been making her own electric cables, and almost entirely, no doubt, in German-controlled factories in Russia. In electric locomotives there is an increase, but the business has been very small. But it was very different with dynamos and the like, the values of the imports of which rose from £161,000 in 1906 to £1,010,000 in 1913.

Although some years back, especially when the Petrograd tramways were being constructed, there appeared to be a strong feeling in favour of purchasing electric cars abroad, the figures published show that the tendency has been seriously interfered with. When it became known that the authorities were disposed to make contracts with foreign car builders, a great agitation was stirred up and the responsible parties were constrained, whilst avowing their conviction that Russian-produced electrical cars would work out dearer and less efficient than foreign ones, to give

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the orders to the national workshops. Thus we find that the number of electrical railway cars imported into Russia in 1906 was 84 and in 1913 106. The smallest number imported between these years was 40 in 1908: and the largest number was 184 in 1912.

The statement to which we have referred goes on to show from what countries Russia obtained her supplies. Briefly stated, it was Germany first and the rest nowhere, or practically so. All the same, Germany's position of late years, although easily first in respect to electric railway cars, was not so commanding as it had been in other branches. The importation of cars from Germany in 1908 was 25, the number rising continuously to 131 in 1912. The figures for 1913 per country are not yet published. Belgium, however, exported to Russia 10, 55, and 50 electric cars in 1910, 1911, and 1912 respectively. Austria-Hungary followed with a few cars, whilst Great Britain, apparently the only other competitor, appears in the list with 15 cars to her credit in 1908, and 4 only in 1912, with nothing in between. It is hardly necessary, in order to appreciate Germany's undisputed premier position on the Russian market, to enter into further details. It is of more interest to observe that Russian writers on the subject appear to be unanimously in favour of, and are certainly persistent in, advocating drastic changes in the next commercial treaty that Russia may make with Germany; and there is also a strong feeling expressed that where the national industries fail to supply the national wants it is to Great Britain, America, and France that Russia should apply rather than to Germany. This is no afterthought resulting from the war. For years Russians have been complaining of the German economic hegemony in Russia, and insisting that it must be severely limited and other countries put on more favourable terms to compete with her.

CONDITIONS IN GERMANY.

High Price of Rubber Tires and Petrol.

A letter written by Eugen Eichel, editor of *Elektrische Kraftbetriebe und Bahnen*, of Berlin, and published in the *Electric Railway Journal*, of New York, contains some interesting notes on railway and electric tramway conditions in Germany at the present time. Mr. Eichel says that the war has led to a relaxation in the police rules governing passengers standing in electric railway cars, so that it is now quite common to see a car carrying as many passengers as it will hold. Consequently, the railways are working at a lower service cost than in times of peace.

A number of autobuses and automobiles are still running in Berlin with the consent of the war department, although rubber tires and gasoline are extremely costly. In many cases a mixture of gasoline and wood alcohol is used, as the latter is abundant in Germany. Gasoline is also manufactured largely in Germany as a by-product of the coal-tar industry, and as both tar and coal are at hand in large quantities the question of fuel is not a pressing one.

Naturally the war offers a very favourable opportunity for the exploitation of electric lighting and electric vehicles, since both gasoline and petroleum have risen in price very much. The military authorities, who at first installed petroleum lighting for barracks, military hospitals, encampments and prisoners' quarters, prefer electricity wherever it is possible to make connections with existing central stations or transmission systems. The use of electricity is particularly valuable for prison camps because the wiring and lamps can be so arranged that the turn of a switch will flood any suspicious area with light.

Shaded Lamps for Tramcars.—In accordance with military regulations, the masking of street lights is proceeding in various districts. Tramcar lights must not be more than sufficient to enable the service to be conducted. To meet the situation, a method has been devised of shading all the lamps in a car so as to give a violet light. Cars fitted with the new shades have been approved by representatives of the military authorities, and are said to answer all the requirements of the order in regard to diminished illumination. Shades of the pattern referred to are in use on the cars of the London County Council, the London United, Ilford Corporation, Birmingham Corporation, and other lines. J. W. Courtenay, Limited, tramway advertising contractors of Amberley House, Norfolk Street, London, W.C., inform us that they will be glad to send sample shades on request.

ELECTROLYTIC ACTION OF RETURN CURRENTS IN ELECTRIC TRAMWAYS ON GAS AND WATER MAINS; AND THE BEST MEANS OF PROVIDING AGAINST ELECTRICAL DISTURBANCES.*

By H. E. Yerbury.

This paper opens with reference to the systematic study which has been given to the causes of corrosion, and epitomises the theories which have been evolved as a result of such study. The author favours the electrolytic theory, as its effect can be demonstrated. The process is moreover in full accord with modern thought, based on the fact that metals have a definite solution pressure, and by the Nernst formula this and an osmotic pressure are all that are required for E.M.F. and hence for corrosion.

Electrolysis may be intensified by an extraneous or leakage current from, say, electric tramways worked, as they invariably are, by an uninsulated track. A case is cited where a protective clause was inserted by a gas company against possible injurious action by such leakage currents. Board of Trade rules and regulations, and their revisions, from 1894 to the present date are criticised. The influence of a leakage current on reinforced concrete is dealt with. It is assumed that concrete conducts electrolytically and not like a metal, and cases are recorded where electrolysis has been attributed to an impurity—such as calcium sulphate—which was added to cements of American make to retard quick setting. The seriousness of the mechanical effects due to the products of corrosion is pointed out in connection with reinforced concrete structures.

The constitution or structure of metals has undoubtedly an influence on the effects of electrolytic action, and white cast iron has been proved to be less susceptible to corrosion and pitting than grey iron, as it contains less graphitic carbon and silicon. The influence of high percentages of silicon in cast and wrought iron is cited. In the subject matter of the paper the causes and results of pitting have not been specifically dealt with, apart from general corrosion, and the expression "damage to pipes" is to be understood to mean both local pitting and general corrosion.

The preventive measures proposed by British and Continental authorities in order to reduce the P.D. between tramway tracks and pipes are classified, and a description of the function of a negative booster is given in detail. Two theoretical diagrams are given to show the working and effect of a booster system as compared with unboosted negative return conductors. Where the rails and the mass of earth are positive to pipes in the vicinity of the track, there can be no danger to pipes in that area, as they are cathodic. On the other hand, danger exists to all pipes and metallic structures (where embedded in soil) which are positive to the rails, as it is the flow of current out of the pipes that has a tendency to cause corrosion and pitting. The danger, however, is nothing like as great as would appear from the theoretical standpoint. Obviously, if the boosted and unboosted return conductors bonded to the rails are kept at or about the same potential, the ideal system as affecting leakage currents is brought about.

Assuming that the potential of the rails, at some point where a negatived boosted conductor is bonded, is lowered to an abnormal degree, it follows that pipes carrying a leakage current are invited to give up their charge, as the difference of potential is thereby increased. This fact is appreciated by the Board of Trade, as one regulation stipulates that the direction of the current should be reversed by interposing one Leclanché cell (1·48 volts) if the current is from the pipe to the return, whereas up to 4·4 volts are allowed where the direction of the current is from the uninsulated return to any pipe in the vicinity. Results of actual P.D. and current tests on Sheffield pipes in various parts of the city are shown. As current density and duration of current are the most important factors in connection with injurious electrolytic action of or on gas or water pipes, potential readings are somewhat misleading, as it is now well known that where a comparatively high difference of potential exists there is, as a rule, less injurious current passing. This is largely attributable to the counter E.M.F. of polarisation. In Sheffield, when the tramway system and generating station have been shut down, differences of potential up to 0·66 volt have been observed on pipes.

Board of Trade regulations in respect to leakage currents can easily be complied with on all tramway undertakings, and are absolutely effective in safeguarding the property of other authorities. As 650 volts are allowed as a generating or transforming pressure, in the author's opinion up to 600 volts could be allowed between overhead conductors and earth, as 10 per cent. is often the maximum drop on a tramway system. This increase of voltage would reduce the cost of feeders and also the heavy currents now dealt with. Electrical disturbances, apart from return currents, are mentioned, such as electro-magnetic and electrostatic induction. Single-phase alternating current railways are especially troublesome. Telephone-circuit

* Abstract of a paper read before the Institution of Civil Engineers, February 23, 1915.

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interference is chiefly due to harmonics of such a frequency as to come within the range to which the ear is sensitive. Voltage waves from generators and transformers are usually distorted and do not vary uniformly according to the sine law. Star-connected alternators with earthed neutral point frequently cause disturbances in neighbouring telegraph and telephone systems, due to the presence of triple-frequency harmonics in the pressure wave.

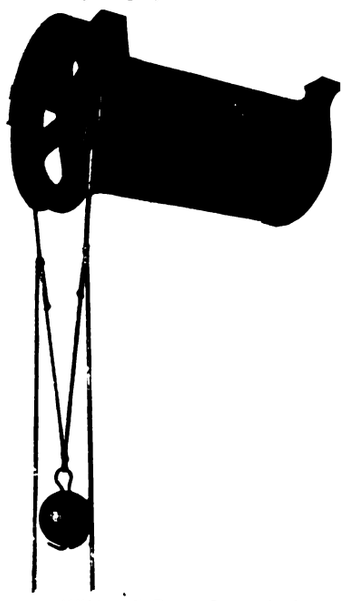
The interference with telegraphs and telephones is not entirely confined to alternating-current systems, and trouble has been experienced by pulsating direct current set up by the generators or rotary converters. Special study of each individual case is required before a remedy can be applied. It is desirable, however, that in continuous-current generation and distribution the generators should produce a current without appreciable pulsation, and for alternating work generators having a pure sine wave should be used. The influence of magnetic fields near tramway tracks has not been considered in the paper, as such disturbances only appreciably affect magnetic observations.

The paper concludes with a summary, and a theory is put forward that incrustation in the bore of pipes is often caused by local electrolytic action. This growth might be started as a speck of rust, thus forming with the iron a galvanic couple, the oxide being electro-negative to iron. The electrolyte might be created by the secretions of animalculæ or other acids. This nucleus would then establish a closed circuit, and the growth would continue by the increased bulk of oxide acting as a shell to retain the electrolyte. Iron pipes should be subjected at a proper temperature to a dipping in some bitumastic solution so as to form a tough adherent covering. This appears to be the best preventive against internal and external corrosion or pitting.

The author suggests that a field of research is open to metallurgists to determine whether corrosion of wrought iron and steel is due to local electrolytic couples set up by some internal crystalline arrangement or to thermal or mechanical stresses in manufacture. It appears that cold-worked metal is generally anodic and can be changed to a cathodic condition by annealing. When cold-worked and unworked metal are in contact the possibility of an electrolytic couple exists. Alternating stress steel is also a potential cause of corrosion. Metallic connections to the rails, such as bonds from tramway poles and feeder pillars, should be as few as possible, and all pipes should be kept at least 2 ft. from the track. All rail joints should be tested periodically. Where joints are welded, a copper bond is recommended as a precautionary measure in case of a high resistance being set up by a badly welded joint, which resistance in course of time would be intensified by additional oxidation.

"WITTON" ROPE-OPERATED CONTROLLERS.

The rope-operated controller is a device which, although most commonly employed on hoists and monorail runabouts with ground control, frequently finds application in other classes of work. The design illustrated, which is manufactured by the General Electric Company, Limited, of Witton, Birmingham, and 67, Queen Victoria Street, London, E.C., is largely used on Witton-Kramer hoists, but a considerable number have been supplied for the control of motors supported from the ceiling. The controller is the standard "Witton" type 1a, and, if desired, in the smaller sizes, can have the resistance contained inside the controller itself. It is of the reversing pattern, with weight return to the "off" position. This design of controller can be supplied to control motors up to 25 H.P. on continuous-current circuits and 16 H.P. on alternating-current circuits. It is suitable for series, compound, or shunt-wound motors, and, if desired, can be provided with electric braking stops.

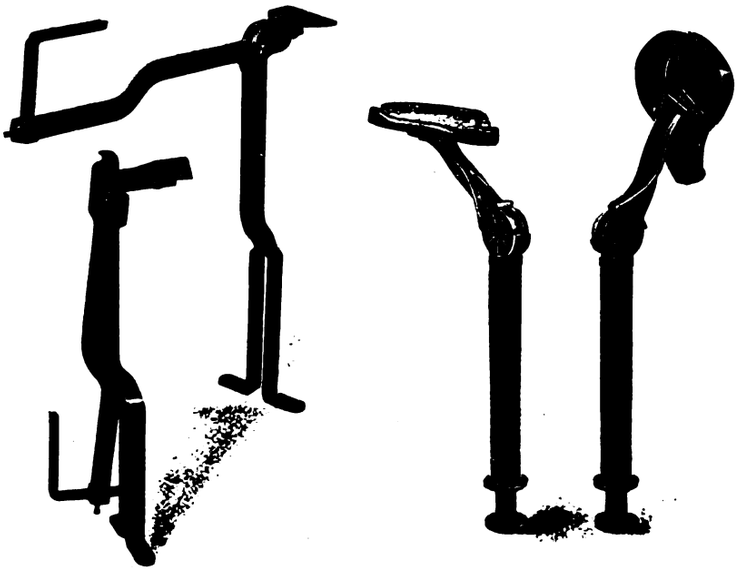


"Witton" Rope-Operated Controller.

SEATS FOR TRAMCAR MOTORMEN.

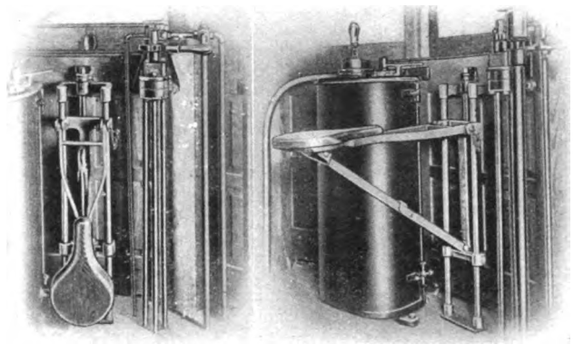
There appears to be some revival of the movement for providing motormen with seats, so that, leaving aside for the moment the arguments for and against such a change, interest attaches to the designs which manufacturers are putting forward to meet the peculiar requirements which such a seat must fulfil. We give here a brief description, with illustrations of patterns which are now being put on the market.

The J. G. Brill Company have three types of seat, the movable saddle, the stationary saddle, and the movable circular types. In the first two of these the seat proper is shaped something like a bicycle saddle. It is supported on a column cranked considerably at about two-thirds of the height. The saddle in each case is 12 in. long by 11 in. wide. In the case of the movable saddle, there is a pin adjustment for four heights—27⅛ in., 28½ in., 29⅞ in., and 31¼ in. from the floor to the top of the seat. The seat folds against the dasher, and the height when folded with the adjustment at the lowest notch is 33½ in. The distance from the centre of the support to the outside edge of the saddle, with the seat in position for use, is 14½ in. The cast support is 2½ in. in diameter, and it has a pin to fit in a floor socket. The details of the stationary saddle type are similar, except that it has an oval base, 9½ in. long by 6 in. wide, screwed to the floor. In regard to the movable circular type, the seat is 10½ in. in diameter and has a screw adjustment for height. The support is 1 in. in diameter, with a pin to fit in the floor socket. The support can be made any length required.



Brill Seat for Motormen.

The Equipment and Engineering Company have a type called the "Keystone" motorman's seat. This also is a saddle-shaped seat, but it is supported on a bracket which is attached to a double upright rising from the car platform. The whole appliance is permanently attached to the platform floor and dash, and the seat may be instantly collapsed by giving the under supporting rod a kick with the foot. The bracket and seat then drop down close against the upright, and are entirely out of the way. The seat is adjustable as to height, so that the driver can put himself in the best position for working the controls. When in



Keystone Seat for Motormen.

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position for use the seat projects from the dash for 30 in., and the height adjustment is from 23 in. to 30 in. When collapsed, the seat projects from the dash only 5½ in.

BOOKS AND OTHER PUBLICATIONS.

Distressed Dublin.

This story of the Great Strike of 1913-14, by Arnold Wright (325 and xii. pp. 9 in. by 6 in., cloth 3s. 6d. net, Longmans, Green, and Company, London), gives a succinct and impartial history of the Larkinite movement in Dublin. This began in 1908, and continued until the resumption of the normal industrial life of the city, early last year, after Mr. Larkin's attempt at planting syndicalism on Irish soil had been defeated for the present. Mr. Wright studied the subject on the spot, indeed he interviewed the prime mover; consequently his history is complete, moreover it is well written, and does full justice to the stalwarts of the Employers' Federation under the leadership of Mr. W. M. Murphy. Of course, James Larkin looms large in the pages of this historical work; in fact the references to him fill two columns out of 20 in the capital index. Mr. Wright's book should be carefully read by all those who wish well to the warm-hearted and impulsive Irish people, and should be carefully kept for reference as a faithful record of an exciting episode in Dublin life, which it is to be fervently hoped will not recur.

Peckham Long Wheel Base Trucks.

Mr. Edgar Peckham may well be considered the Nestor of tramway truck designers. The first Peckham trucks were tried many years ago on the introduction of electric traction by some of the important tramway systems in the United States. Subsequently they crossed the Atlantic and have been largely used in the United Kingdom. They are now made by the Peckham Truck and Engineering Company, Limited, St. James' Park Chambers, 32, Broadway, Westminster, S.W., who have recently published a handsome pamphlet (40 pp., 11 in. by 9 in.) fully illustrating and describing the Peckham patent pendulum and radial gears and long wheel base tramway trucks. Clear line drawings are given of the pendulum axle gears as applied to ordinary and maximum bogie trucks, of the radial axle truck on four-wheeled vehicles, and of brake mechanism. These will enable anyone to understand how these ingenious devices and the general design of the under frames extend the effective wheel bases many feet, and enable long cars to run easily round curves and without galloping on straights, whether on the smaller single trucks or ordinary bogie trucks, or on those called maximum traction. The longest British car on two axles is a double-decked one built for the Southend Corporation; the length of the body is 22 ft. 6 in., the length over all is 33 ft., the wheel base is 13 ft. 6 in., the effective wheel base 16 ft., and spring base 22 ft. The brake mechanism can be operated by hand or air brakes only and in combination with magnetic brakes; while the Peckham patent axle boxes are dust and oil tight.

The Practical Electrician's Pocket Book, 1915.

The sixteenth edition of this handy little work (by S. Rentell and Company, 36, Maiden Lane, Strand, W.C.) comprises 629 pages, and contains much information for the practical electrician. Since the last issue the book has been revised and the chapters have been rearranged, enabling the text to be condensed and room to be made for new matter. Fresh sections deal with the synchronome clock system, half-watt lamps, C.T.S. wiring and the Zed fuse, electric heating and cooking, etc. The price of the book is one shilling, and an extra sixpence insures the sum of £25 in case of death from electric shock.

Rotary Converters.

According to its sub-title, this pamphlet professes to describe "Rotary Converters, their Uses and Operation," and the contents amply fulfil the promise. Beginning with a clear and practical account of the characteristics of rotary converters, the writers set forth the advantages accruing from use of these appliances. In the chapter on general construction, the whole internal economy of the rotary converter is laid bare, showing both by text and illustration the gears required for direct and alternating current. Useful directions are added for the starting and regulation of those highly-effective aids to electric power users. The book is lavishly illustrated with reproductions of photographs and diagrams, and the printing leaves little to be desired. Copies may be had on application to the British Westinghouse Electric and Manufacturing Company, Manchester.

Tools for Engineers and Woodworkers.

This is the forty-first edition of a "small tool" catalogue issued by Messrs. Charles Churchill and Company, Limited, 9 to 15, Leonard Street, Finsbury, London, E.C. The book, which measures 11 in. by 9 in. by 1¾ in., contains 438 pages, and the index to the contents, arranged in three columns, covers no less than six pages of small print. as glazed paper is used throughout the illustrations are excellent, and form a complete range of mechanics' tools and workshop accessories, together with a large variety of carpenters' tools. Prices are quoted in every case. Messrs. Churchill publish another catalogue, dealing with machine tools and engineers' supplies generally.

Oil Conquest of the World.

"The Oil Conquest of the World," by Frederick A. Talbot, 310 pp., 80 full-page illustrations from photographs, 8¾ in. by 5½ by 1⅜ in. In cloth 6s. net (William Heinemann, London). This is one of the "Conquests of Science" series to which the author has contributed already. The subject is a fascinating one, and Mr. Talbot treats it exhaustively. He acknowledges the assistance he has received in giving this popular account of the oil industry—its beginning, development, and future prospect. As he truly says, "the average individual fails to recognise how dependent we have become on this commodity." A perusal of this book will enable every one to appreciate what has been done by the pioneers and present workers in this indispensable aid to the work and advancement of the world's commerce and industry.

B.T-H. Descriptive Price Lists.

The British Thomson-Houston Company have recently issued several new price and descriptive lists. Near the close of last year the company put on the market continuous-current motors of a type they denoted as "D R," embodying improvements based on experience of the working of the "D G" type continuous-current motors. On the same progressive lines, we now have from them a descriptive list of a "D R" type of continuous generators. We have also received from the British Thomson-Houston Company price lists for lightning arresters and alternate-current brake magnets, containing the latest improvements in these appliances. Each list contains a careful and detailed description of the uses and capabilities of the appliances, with fine illustrations and diagrams.

Roll of Honour.

The British Aluminium Company have issued in the form of a splendid roll of honour, a complete list of their directors, officials, and workers who have enlisted in the nation's military services by sea and land. Under a group of typical soldiers and naval men is the everlasting motto: "*Dulce et decorum est pro patria mori*," and beneath extend the long columns of names, giving the regiment and rank of each man. Printed in colours on glazed paper, the "roll" is a worthy production.

C.A.V. Car Lighting and Starting.

A. Vandervell and Company, Acton, London, W., have issued a neat desk memo book, with indexed forms for names and addresses, and a tear-off memo tablet. The production is strongly bound, and should be a useful adjunct to the desk of business men.

Modern Machine Shop Practice.—Alfred Herbert, Limited, of Coventry, issue a monthly publication which although primarily an advertising circular of the firm contains so much interesting matter, specially appealing to engineers and other machine-tool users, as to have a claim to be considered a journal. Articles on "Grinding Wheels," "Twist Drills," and other subjects give the journal a technical value. An article headed "Some Impressions of Russia," though really a letter written by an employee of the firm in 1906, contains a good deal of information specially interesting at the present time. As we have hinted, the bulk of the "Review" is taken up with descriptions of the machine tools made and stocked by Alfred Herbert, Limited, and price lists.

Gillespie and Beales' Calendar.—This firm has sent out from Amberley House, Norfolk Street, Strand, London, W.C., an interesting calendar for 1915. It contains portraits of the allied sovereigns, President Poincaré, and the chiefs of the armies and navies. Displayed flags of the Allies, types of British soldiers, warships, and aeroplanes are shown in colour with fine effect.

Messrs. C. C. Wakefield and Company have issued an illustrated booklet describing their mechanical lubricators, which are made with either single or double-acting pumps, having the feeds separately adjusted from either inside or outside of the oil reservoir. The pamphlet contains numerous illustrations of modern types of engines fitted with these lubricators.

Electric Vehicle Signs.—The General Electric Company, Limited, are sending out a leaflet giving specifications for various types of the Electric Vehicle Committee's standard electric sign. The illustration shows a most effective design, and the prices quoted are moderate.

Salford Circuit Breaker.—A leaflet of interest to mining engineers has been issued by the General Electric Company, Limited, describing the structure and use of the "Salford" circuit breaker, which complies with the stringent regulations laid down by the Home Office regarding switch gear for erection in fiery mines.

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DEVONPORT TRAMWAYS ACCIDENT.

BOARD OF TRADE REPORT.

Lieut.-Colonel Druitt's report on the inquiry into the circumstances under which a car belonging to the Devonport and District Tramways Company was overturned at the bottom of Tamar Terrace, Devonport, on November 27 last, causing three deaths and seriously injuring eight persons, contains many points of interest. The report states that the car is of the double-deck single-truck type, fully equipped with hand-wheel, mechanical track slipper, and electrical emergency brakes, two sand boxes at each end, and has accommodation for 46 passengers, 22 inside and 24 outside. The permanent way, which was in excellent condition, consists of inner rails of 100 lb. per yard, with special heavy lip, outer rails 95 lb. per yard, with granite paving setts, the gradients ranging from 1 in 18 to 1 in 11 on the hill, which terminates in a curve having a radius on the outer rail of 80 ft. The gauge round the curve may be said to be "true" or slightly tight to gauge. At the top end of the curve the super-elevation of the outer rail is 1 in., varying from 1¼ in. to 1½ in. for a length of 90 ft. Judging by the position of the car after the accident, it must have fallen over where the super-elevation is 1¼ in., which is quite sufficient for a speed of six miles per hour. The accident occurred shortly after seven o'clock on a damp morning, and the rails were in a greasy condition. Another factor to be taken into account is the fact that the car was overcrowded with adult passengers. Car No. 25 was a special provided for taking home dockyard men who had finished work about seven a.m., and on the morning in question was rushed and overcrowded by the dockyard men. Claims for accident compensation have been received by the company for 72 persons, but it appears to the inspector that the number actually on the car was 66, not counting the driver and the conductor. The regulations for operating the section concerned are as follow: *Speed:* In Tamar Terrace between Stopford Place and Trafalgar Road, four miles an hour; on the road east of Technical Schools from Trafalgar Road into Paradise Road, two miles an hour. *Stops:* At Stopford Place, on a gradient of 1 in 40; before crossing Trafalgar Road, on a gradient of 1 in 16; at the bottom of the road before turning into Paradise Road, on a gradient of 1 in 11. Evidence showed that the car had become overcrowded a considerable distance before arriving at Stopford Place, where it was brought to a standstill. The motorman gave the car "a notch or two of power" on leaving that point, though he also applied the track brake. Going down Tamar Terrace the car gathered such momentum that it could not be pulled up at the next compulsory stopping place at Trafalgar Road, and continued to gain speed till it came to the curve where "the car appeared to come to a standstill and tipped over." The Board of Trade inspector concludes: "Judging by the evidence, I consider the primary cause of the accident was that the motorman exceeded the proper speed coming down Tamar Terrace, and, in consequence, was unexpectedly unable to stop the car at Trafalgar Road, so he came on to the 1 in 11 gradient at a certain speed. If a car is started down such a gradient at only a slow speed it is much more likely to attain a velocity which may render it difficult, if not impossible, to keep it under control than if it started from rest. The result was that, in trying to control the car, he used the electric emergency brake in combination with the hand brake, and locked the wheels, and when the car in this condition reached the curve the wheels got jammed, and the displacement of the live load, combined with the effect of centrifugal force, caused the car to overturn. It is probable that if he had released the hand brake as the car reached the curve it would have got round without overturning, as the track was in excellent wear and the super-elevation of 1½ in. is sufficient for a speed of six miles an hour.

"It is possible that the extra weight in the car may have contributed to the motorman's failure to stop the car at Trafalgar Road owing to his not having put on the slipper brake with sufficient force, and it is quite possible that the extra live load in the car was the cause of its overturning as explained above. Thus the overcrowding must be regarded as a considerable contributory cause to the accident, and it is dangerous for cars to be overloaded in the way this one was."

ART AND RAILWAY TICKETS.

A hitherto unsuspected relation to art is about to be claimed for the railway ticket, seeing that the backs of the tickets issued by the Metropolitan Railway are to be illustrated by a variety of designs expressly drawn by Hassall. A new poster, "It is a pity to puncture the picture," also by Hassall, where the artist manages to insinuate a subtle compliment to himself, will shortly be on view at all Metropolitan railway stations. The Hassall drawings are to be employed in connection with approved advertisements which the Metropolitan Company have arranged to have printed on the backs of all their tickets. Although the idea of utilising railway tickets for publicity purposes is not new, the combination of art and advertising in the manner now proposed and in conjunction with posters is quite original. It was initiated by Messrs. S. Davis and Company, of 30-31, St. Swithin's Lane, London, E.C., who have been appointed sole agents for advertising on the tickets of the Metropolitan Railway.

TRAMWAY RATEABLE VALUE AND OMNIBUS COMPETITION.

HOUSE OF LORDS' DECISION IN FAVOUR OF TRAMWAYS.

The House of Lords, as the supreme Court of Appeal, on February 22 decided in favour of London County Council as against Islington Borough Council, the result being that the tramways of the former body, so far as these are situated in Islington, will be revalued for the purposes of rating, on the ground that their assessable value has been reduced by motor omnibus competition. The noble and learned Lords who heard the appeal were the Lord Chancellor, Lords Atkinson, Parker, Sumner, and Parmoor.

The action was originally raised by an application by London County Council for a *mandamus*. The following statement of the facts and legal aspects of the case is extracted from the *Times* law reports, and puts the situation in concrete form.

The proposed *mandamus* was one calling on Islington Assessment Committee, under section 47 of the Valuation (Metropolis) Act, 1869, to appoint a valuer to make a provisional valuation list showing the reduction in the rateable value of the County Council tramways situated in the borough of Islington owing to the competition of motor omnibuses. The Valuation (Metropolis) Act, 1869, section 47, provides: "If in the course of any year the value of any hereditament is increased by the addition thereto or erection thereon of any building, or is from any cause increased or reduced in value, the following provisions shall have effect:

"(1) The overseers of the parish in which such hereditament is situate may, and on the written requisition of the Assessment Committee or of any ratepayer of the union or of the surveyor of taxes for the district shall, send to the Assessment Committee a provisional list containing the gross and rateable value as so increased or reduced of such hereditament;

"(2) A copy of the requisition shall be sent by the person making it to the clerk of the Assessment Committee, and if within 14 days after the requisition has been served on the overseers they make default in sending such provisional list he shall forthwith summon the Assessment Committee, and the Assessment Committee shall appoint a person to make such provisional list, in the same manner as is in this Act provided in the case of the overseers failing to transmit a valuation list."

In 1912 and 1913, owing to the competition of motor omnibuses, the gross receipts from the County Council tramways in Islington had fallen from 11·42d. per car-mile to 9·05d., and on April 4, 1913, a requisition by the London County Council was served on the Islington Borough Council, as overseers of the parish, requiring of them to send to the Assessment Committee a provisional valuation list showing the reduction in the rateable value of the tramways, on the ground that they had been reduced in value within the meaning of the section. The Borough Council declined to accede to the requisition, and on an application by the London County Council to the Assessment Committee that body came to the conclusion that there was "no *prima facie* evidence of such a reduction as is contemplated by the section," and they therefore declined to appoint a valuer.

The London County Council then applied to the Divisional Court for a *mandamus* directing the Assessment Committee to appoint a valuer, and the Court ordered that the *mandamus* should issue. The Court of Appeal (Lords Justices Swinfen Eady and Kennedy, Lord Justice Vaughan Williams dissenting) discharged this order on the ground that no *prima facie* case of a reduction in value resulting from a cause of a permanent nature had been made out, and that the Assessment Committee had properly declined to accede to the request of the London County Council. Counsel, on behalf of the appellants, contended that in ascertaining whether there was a reduction in value of the tramways within the meaning of that section, the comparison was to be made between the actual year in question and the immediate preceding year, and not between the actual year and the year immediately preceding the quinquennial list. At the conclusion of the appellants' arguments the Lord Chancellor intimated that their Lordships were of opinion that the comparison should be made between the year in question and the year immediately preceding the quinquennial valuation list, as was held by Lord Esher and Lord Justice Bowen in Reg *v.* Poplar Union, but they desired to hear the respondents' counsel as to the duty of the Assessment Committee in dealing with the application of the London County Council for a provisional list.

After counsel for the respondents had been heard, the Lord Chancellor expressed his opinion that it was not necessary that the provisional list should show a reduction, and intimated that their Lordships would allow the appeal, but that the form of the order for a *mandamus* would be altered so far as it provided that the provisional list must show a reduction. They would give the reasons for their decision at a future date.

Mr. Edward Ryde, K.C., and Mr. Konstam, instructed by Mr. Edward Tanner, appeared for the appellants; Sir Robert Finlay, K.C., Mr. Ernest Charles, K.C., and Mr. Arthur Page, instructed by Mr. A. M. Bramall, for the respondents.

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TRAMWAY AND RAILLESS TRACTION BILLS.

ABERDARE URBAN DISTRICT COUNCIL (TRAMWAYS, ETC.).

Proposed Borrowing Powers.—For purchase of lands for new tramways, the sum requisite; for construction and equipment of new tramways, £46,500; for provision and equipment of railless routes, £6,900; for motor omnibuses, £8,500.

Length of Proposed Tramways.—Double line, 52 chains; single line, 4 miles 37 chains. To authorise the Urban District Council of Aberdare to construct and work additional tramways, to equip and work additional trolley vehicle routes, to provide and run motor omnibuses on specified routes, all within their district; and for other purposes.

BRISTOL TRAMWAYS.

To revive and extend the powers for the acquisition of lands, and to extend the time for the construction of certain authorised tramways of the Bristol Tramways and Carriage Company, Limited, under their Acts of 1904 and 1911; and for other purposes.

DEWSBURY CORPORATION.

Proposed Borrowing Powers.—For construction of new tramway and other purposes of the Corporation's tramway undertaking, £8,190; for electrical equipment, etc., of new tramway, £200; for purchase of land for and for provision of a depot for tramways and omnibuses, £7,535.

Length of Proposed Tramway.—Double line, 5 chains. *Inter alia*, to authorise the Corporation of Dewsbury to construct and work an additional tramway within their borough, and to provide and run motor omnibuses; and to confer running powers over certain neighbouring lines.

HALIFAX CORPORATION.

Proposed Borrowing Powers.—For construction of new tramways, £110,000; for tramway rolling stock, £14,000; for trolley vehicles, £5,100; for electrical equipment, etc., in connection with tramways and trolley vehicles, £26,300; for extension of tramway depot, £6,000; for motor omnibuses, £3,600.

Length of Proposed Tramways.—Double line, 5 miles 67 chains; single line, 5 miles 64 chains. To authorise the Corporation of Halifax to construct and work additional tramways within and beyond the borough, to equip and work additional trolley vehicle routes, to run motor omnibuses over additional routes, to use trailer and coupled carriages on the Corporation tramways, to enter into agreements as to postponement of purchase of tramways by local authorities, and for other purposes.

LINCOLN CORPORATION.

Proposed Borrowing Powers.—For trolley vehicles, £10,200; for trolley equipment, £5,500; for omnibuses, £10,800; for buildings for purposes of trolley vehicles and omnibuses, and for extension of generating station, £9,050.

To authorise the Corporation of Lincoln to provide and work trolley vehicles on specified routes within and beyond the city, to provide and run motor omnibuses, to use trailer and coupled carriages on the Corporation tramways; to empower the Board of Trade to authorise new trolley routes by Provisional Order; and for other purposes.

LONDON COUNTY COUNCIL (TRAMWAYS AND IMPROVEMENTS).

Proposed Borrowing Powers.—For construction and equipment of new tramways, the reconstruction of existing tramways, and the purchase of lands therefor, and for other purposes of tramway undertaking, £198,400.

Length of Proposed Tramways.—Double line, 1 mile 49 chains; single line, 54 chains. To authorise the London County Council to construct and work additional tramways, partly outside their area, to reconstruct certain existing lines, to take lands, and to make street improvements; to apply certain provisions of earlier Acts; to extend the time for the construction of certain lines authorised by Act of 1908; to exempt certain portions of the new tramways from the operation of section 43 of the Tramways Act, 1870, as to future purchase by local authority; to amend section 29 of the Act of 1912 as to use of trailer and coupled carriages; and for other purposes.

PLYMOUTH CORPORATION.

Inter alia, to consolidate with amendments the provisions relating to tramways of the Acts and Orders of the Corporation of Plymouth; and to empower the Corporation to provide and run omnibuses within the borough.

RHONDDA URBAN DISTRICT COUNCIL TRAMWAYS EXTENSIONS, ETC.

Proposed Borrowing Powers.—For construction of new tramways, £25,568; for equipment, £2,400.

Length of Proposed Tramways.—Double line, 1 mile 46 chains; single line, 48 chains. *Inter alia*, to authorise the Urban District Council of Rhondda to construct and work additional tramways within their district.

ROTHERHAM CORPORATION.

Proposed Borrowing Powers.—For construction of new tramways and alteration of levels of road, £56,000; for tramway equipment, £7,000; for motor omnibuses and erection of accommodation therefor, £9,200.

Length of Proposed Tramways.—Double line, 62 chains; single line, 4 miles 72 chains. *Inter alia*, to authorise the Corporation of Rotherham to construct and work additional tramways within and beyond the borough, to extend the powers of the Corporation as to the running of motor omnibuses; and to confer on the Corporation and the Corporation of Sheffield running powers over certain portions of each other's tramway systems.

SHEFFIELD CORPORATION (TRAMWAYS).

Proposed Borrowing Powers.—For purchase of Rotherham tramway, the sum requisite; for construction and equipment of new tramways and for general purposes of tramway undertaking, £17,520; for motor omnibuses, £4,735.

Length of Proposed Tramways. Double line, 45 chains; interlacing line, 1 chain. To authorise the Corporation of Sheffield to construct and work new tramways within the city, and to purchase from the Corporation of Rotherham a portion of tramway situate within the city; to extend the powers of the Corporation as to the running of motor omnibuses; and for other purposes.

SOUTH SHIELDS CORPORATION.

Proposed Borrowing Powers.—For construction of new tramways, £15,392; for equipment of new tramways and for general purposes of tramway undertaking, £1,319; for motor omnibuses, £3,600.

Length of Proposed Tramways. Double line, 68 chains; single line, 7 chains. *Inter alia*, to authorise the Corporation of South Shields to construct and work additional tramways within the borough, and to provide and run motor omnibuses.

STALYBRIDGE, HYDE, MOSSLEY, AND DUKINFIELD TRAMWAYS AND ELECTRICITY BOARD.

Proposed Borrowing Powers.—For construction of new tramways, £57,300; for equipment of new tramways and for general purposes of tramway undertaking, £20,000.

Length of Proposed Tramways. Double line, 1 mile 21 chains; single line, 5 miles 5 chains. *Inter alia*, to authorise the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board to construct and work additional tramways, to use trailer and coupled carriages, to enter into agreements for purchase of tramways of the Oldham, Ashton, and Hyde Electric Tramway, Limited, the Corporation of Hyde, and the Urban Electric Supply Company, Limited, and to provide and run omnibuses; and to enact certain provisions as to future purchase of the new tramways by local authorities, in lieu of the provisions of section 43 of the Tramways Act, 1870.

SUNDERLAND CORPORATION (WEARMOUTH BRIDGE).

Inter alia, to authorise the Corporation of Sunderland, in connection with the reconstruction of the Wearmouth Bridge, to divert the tramway crossing the bridge.

Proposed Borrowing Powers.—£696,809 (total).

Length of Proposed Tramways.—Double line, 13 miles 15 chains; single line, 21 miles 47 chains; interlacing line, 1 chain.

CORRESPONDENCE.

THERMIT, LIMITED.

TO THE EDITOR OF THE TRAMWAY AND RAILWAY WORLD.

DEAR SIR,—I should be glad if you could find room in the columns of your publication for the following statement:

By order of the High Court upon application of the Board of Trade I have been appointed controller of Thermit, Limited, as it appeared to be in the public interest that the company's business should be continued without interference. In view of my appointment, which does not in any way reflect upon the management of the company in this country—as was stated by counsel for the Crown in open court—I am in a position to assure you that no moneys or profits will reach the alien enemy shareholders of the company.

As regards the patents, the Board of Trade have decided to avoid two patents belonging to the company, viz., Nos. 10859/01 and 24439/02, the first of which would, in any case, have lapsed in about three months from now, and the second about a year after. The company, however, do not regard the loss of these patents as a very serious matter, as for modern practice welding they rely on a number of subsequent improvements, besides certain secret knowledge which will enable them to deliver material of exactly the same welding properties as they have hitherto supplied.

All materials, etc., required for rail welding are manufactured in the company's works at 675, Commercial Road, London, E., and both the office staff and workmen employed are exclusively of British nationality.

Yours faithfully,

ARTHUR TAYLOR, *Controller*.

Partner in the firm of Hudson, Smith, Briggs, Smith, and Taylor, Chartered Accountants, London and Bristol.

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CENTRAL LONDON RAILWAY.

We append a summary of the report of the Central London Railway for the year ended December 31, 1914, together with the figures for the previous year. The report of the company is presented in the form rendered compulsory by the Railways Accounts Act, 1911, and very full and interesting information is thus available in regard to the working of the undertaking. As will be seen, the working costs are extremely low considering the character of the service given by the railway, although the percentage of total traffic expenditure to receipts is 59·67, an increase of 8·20 per cent. as compared with the result in the previous year. The cost of energy per unit is no greater than ·504d., a very satisfactory showing. Unfortunately, the gross receipts show a decrease of £10,146, and although there was a saving in expenditure of £3,182, the income from rents, interests, etc., was less by £3,577, so that the net loss in income was £10,541, with the result that the dividend on the ordinary stocks had to be considerably reduced. The extension of the line from the Bank to the Mansion House has not yet given the results that were expected, but it has, at least, prevented the company from feeling more severely still the effect of omnibus competition. With the completion of the western extension the beneficial effect of the connection with the Great Eastern at Liverpool Street will no doubt be greatly increased.

Capital Account.

	1914.*
Capital created:	£
Shares and stock	3,480,000
Loans or debenture stock	1,160,000
Total	£4,640,000
Capital issued:	£
Shares and stock	3,480,000
Loans and debenture stock	926,000
Total	£4,406,000

* There is no change in the capital account as compared with 1913.

	£
Capital expended during year	52,099
Total capital expenditure to date	4,453,200
Capital receipts (including premiums)	4,446,330
Capital expenditure per mile of single track open (exclusive of sidings)	326,840
Estimate of further capital expenditure	1,227,900

Revenue Accounts.

	1914.	1913.
	£	£
Gross railway receipts	244,691	254,837
Railway expenditure	144,359	147,542
Net railway receipts	100,332	107,295
Miscellaneous receipts (net)	32,685	36,263
Total net income	133,017	143,558
Available net income including balance forward	153,896	170,776
Deduct interest and other fixed charges	38,133	38,298
Balance	115,763	132,478
Appropriation to reserve funds	—	—
Full dividend on 4½ per cent. preference stock	21,600	21,600
Balance for dividend on ordinary stocks	94,163	110,878
Dividends on ordinary stocks at 2⅝, 4, and 1¼ per cent. per annum	78,750	90,000*
Balance forward	15,413	20,878

* At 3, 4, and 2 per cent. per annum.

Details of Working Expenses.

	1914.	1913.	Percentage of Traffic Receipts. 1914.	1913.
	£	£		
Way and works	11,222	11,962	4·67	4·77
Rolling stock	16,282	17,249	6·77	6·87
Electric train working	45,830	45,440		
Lifts and escalators	15,615	15,459	34·21	34·58
Traffic expenses	20,815	25,896		
General charges, etc.	33,721	30,732	14·02	12·25
Total traffic expenditure	143,485	146,738	59·67	58·47
Miscellaneous	874	804	—	—
Total expenditure	144,359	147,542	—	—

Details of Receipts.

	1914.	1913.	Percentage of Traffic Receipts. 1914.	1913.
Passenger train traffic:	£	£		
Ordinary passengers	202,576	212,736		
Season tickets	19,935	19,202		
Workmen's tickets	17,518	18,319		
Total passenger receipts	240,029	250,257	99·82	99·72
Mails, parcels, etc.	3,923	5,331		
Less expenses of collection and delivery	*3,488*	*4,628*		
Net mails, parcels, etc.	435	703	·18	·28
Total passenger train receipts	240,464	250,960	100·00	100·00
Miscellaneous	4,227	3,877		
Total	244,691	254,837		

Electric Power and Light Account.

	1914.	1913.
Expenses:	£	£
Superintendence	541	858
Generation	25,653	25,396
Distribution and sub-stations	2,389	2,407
Rates and special charges	3,566	3,493
Total	32,149	32,154

	1914. Number of Units.	1914. £	1913. Number of Units.	1913. £
Current supplied:				
For traction	10,048,245	21,106	9,607,225	20,245
For power	3,651,138	7,667	3,669,319	7,712
For lighting	1,606,428	3,376	1,979,121	4,197
Total	15,305,811	32,149	15,255,665	32,154

Total costs per unit = o·504d.

Statistical Returns.

	1914. Mls.	Chs.	1913. Mls.	Chs.
Length of route of railway	6	66	6	66
Length reduced to single track	13	52	13	52
Sidings reduced to single track	7	58	7	58
Total single track including sidings	21	30	21	30
Length of route authorised but not open	3	27	3	27

	1914. Number.	1914. Carrying Capacity.	1913. Number.	1913. Carrying Capacity.
		Seats.		*Seats.*
Rolling stock:				
Steam locomotives	2	—	2	—
Electric locomotives	2	—	2	—
Motor cars	64	2,576	64	2,576
Control trailer cars	38	1,848	38	1,848
Trailer cars	133	6,408	133	6,408
Total	239	10,832	239	10,832

	1914.	1913.
Train Mileage	1,551,036	1,664,720.

Passengers and Receipts.	1914. Number.	1914. Receipts.	1914. Av. Fare per Pas.	1913. Number.	1913. Receipts.	1913. Av. Fare per Pas.
Ordinary	29,059,282	£202,576	1·67d	30,042,301	£212,736	1·7d.
Workmen	4,427,998	17,518	·95d	4,396,640	18,319	1·0d.
Total	33,487,280	220,094	1·58d.	34,438,941	231,055	1·61d.
Season	4,964	19,935	—	5,124	19,202	—

Aberdeen Opposes Caledonian Railway Proposals.—The Aberdeen Corporation have presented a petition to the Secretary for Scotland against the Caledonian Railway Provisional Order taking power to provide and work omnibuses and other road vehicles. "These powers," the petitioners say, "are so wide as to permit the company to run omnibuses and other vehicles on any route at the sole discretion of the company, and irrespective of whether travelling facilities have already been provided along these routes by the tramway services of your petitioners."

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FINANCIAL REPORTS AND MEETINGS.

Derby Corporation Tramways.—The accounts of the Derby Corporation tramways department for the past year show a net profit of £8,192, as compared with £5,870 in the previous year.

Bruce Peebles and Company.—The directors report a net profit of £3,892, which is deducted from the balance at the debit of profit and loss account, reducing the same to £17,783. Last year the profit was £2,820.

Para Electric Railways and Lighting Company.—The directors recommend a dividend of 6 per cent., less income tax, on the ordinary shares for the year ending December 31, 1914, carrying forward £20,000.

Jarrow and District Electric Traction Company.—Revenue for the past year was £7,869, and the divisible balance is £3,674. A dividend of 3½ per cent. is proposed, adding £900 to the reserve, and carrying £1,026 forward.

Great Orme Tramways.—In their report for the year 1914 the directors of Great Orme Tramways state that the net profit on the year's working is £427. The balance of net revenue account is £1,218, which it is proposed to appropriate by placing £1,000 to depreciation and carrying forward £218.

Fife Tramway, Light, and Power Company.—The report of the Fife Tramway, Light, and Power Company for the year 1914 shows a surplus of £19,271, including the balance brought forward from the previous year. The directors recommend a dividend of 3½ per cent. on the ordinary shares, £3,000 to be carried to reserve, and £2,803 to be carried forward.

Buenos Ayres Tramways.—The directors of the City of Buenos Ayres Tramways Company (1904), Limited, recommend the payment of a balance dividend for the year ending December 31, of 1s. 3d. per share (making 5 per cent. per annum); that the sum of £5,200 be transferred to the general amortisation fund, and £192 carried forward. The warrants were posted on February 16.

Mansfield and District Tramways Company.—At the annual meeting of the shareholders of the Mansfield and District Tramways, Limited, held at Mansfield on February 22, it was stated that the accounts showed a surplus of £13,705, including the balance brought forward from the previous year. The directors recommended payment of a dividend of 6 per cent. for the year on the ordinary shares.

Dublin and Blessington Steam Tramway.—The report of the Dublin and Blessington Steam Tramway Company for the half-year ended December 31, 1914, states that the gross receipts amount to £4,201, the expenses to £4,767, which the directors consider are properly charged against revenue. This shows £566 net loss for the six months, as against a profit of £243 for the corresponding half year of 1913.

Liverpool Overhead Company.—The receipts for 1914 amounted to £91,668. and the working expenses, including appropriation to reserve funds, to £61,244. Including £6,275 brought forward, there is available for dividend £29,943, and a final distribution at the rate of 3½ per cent. per annum (making 3 per cent. for the year) is proposed on the ordinary shares, leaving a balance of £7,012 to be carried forward.

Aberdeen Suburban Tramways Company.—The report of the directors of the Aberdeen Suburban Tramways Company for the half-year ended January 31, 1915, shows a profit of £1,153, making, with the sum carried forward from last half-year, a balance of £2,445 to the profit and loss account. The report also states that the Corporation of Aberdeen have approached the directors with proposals for the purchase of the undertaking.

Lanarkshire Tramways.—The accounts for the half-year ended December 31 show an available sum, after providing for debenture interest, etc., and including £5,645 brought forward, of £19,519 The directors have transferred £9,000 to reserve for depreciation, and recommend a dividend at the rate of 5½ per cent. per annum, as compared with 6½ per cent. per annum for the corresponding period leaving £919 to be carried forward.

Torquay Tramways Company.—The annual report of the Torquay Tramways Company states that the accounts for the year 1914 show a surplus, after providing for payment of debenture interest, and other charges, of £7,625, including £882 brought forward from last balance. The directors proposed to transfer £2,500 to reserve and renewals account, and recommended a dividend of 3½ per cent, leaving £897 to be carried forward. The dividend for 1913 was 5 per cent.

Effect of the War on Cardiff Tramways.—At the meeting of the Cardiff City Tramways Committee held on February 13 the annual report of the tramways manager was considered. The accounts showed an increase up to July, 1914, of £3,000, as compared with the corresponding period of the previous year. Since the war that gain had been changed to a deficit of nearly £2,000. It is estimated that but for the war the traffic receipts would have increased by nearly £6,000.

Mexico Tramways Bond Interest.—It is announced that owing to the continued unsatisfactory condition of affairs in Mexico the directors of the Mexico Tramways Company have decided to defer the payment of the half-yearly coupon due March 1 on the general consolidated first mortgage 50-year 5 per cent. gold bonds. It will be recalled that this company and its allied undertaking, the Mexican Light and Power Company, failed to pay the coupons which fell due on their bonds to January 1 last.

Tramways, Light, and Power Company, Limited.—The report of the Tramways, Light, and Power Company for 1914 states that the net profit, after providing for administration, loan, and debenture interest, amounts to £18,329, including £1,126 brought forward from the previous year. The directors propose to pay a dividend of 6 per cent. on the preference shares, and to carry forward £1,712. It is proposed to create additional capital by the issue of 100,000 6 per cent. cumulative preference shares of £1 each, to provide for extensions of the company's business.

Contribution to Liverpool Rates.—Liverpool city treasurer reported to the Council a reduction of the general rate of 4d. in the £. The reduction was partly due to the contribution of £125,000 from the electric supply and tramway accounts. The Tramways Committee's estimated expenditure on tramways revenue account is £619,908. compared with an estimated expenditure of £598,782, and an actual expenditure of £587,503 during 1914. The income for the past year was £722,325, an increase over 1913 of £7,183. In the electric supply account provision is made for the expenditure of £74,150 on capital account, £114,248 on reserve and renewal account, and £305,038 on revenue account and for interest and sinking fund.

South Metropolitan Electric Tramways and Lighting Company.—The report of this company for the year 1914 shows good results. The revenue account amounts to £43,054, which, with £5,570 brought forward, makes a total of £48,625. Deducting £13,084 for interest on debenture stock paid and accrued, and £6,696 for interim dividends paid on preference shares, there remains a balance of £28,844, which the directors propose to appropriate as follows: To payment of final dividend upon 7 per cent. cumulative first preference shares, £5,003; to payment of final dividend on 6 per cent. cumulative second preference shares, £2,250; to depreciation account, £5,000; to expenses of share issues, £1,000; to reserve account, £10,000; to be carried forward, £5,591.

Glasgow Subway Railway.—The directors' report shows that the balance at credit of net revenue account for the year is £10,852, from which falls to be deducted the interim dividend of 1 per cent. paid on £450,700 of preference shares, £4,507, leaving an undivided balance at December 31, 1914, of £6,345, out of which the directors recommend that a dividend of 1¼ per cent. be paid on the £450,700 of preference shares, making, with the interim dividend already paid, a total of 2½ per cent. for the year, and leaving a balance of £711 to be carried forward. The receipts amounted to £53,787, an average of ·91d. per passenger. Passengers totalled 14,115,096, a decrease of 450,000 as compared with last year. The railway is worked by cable traction, and the total train mileage was 199,142, the cable mileage being 154,742, excluding 3,351 miles run for inspection of cables.

Sunderland District Electric Tramways Company.—At the annual meeting of the Sunderland District Electric Tramways Company, held on February 22, the chairman of the company, Mr. H. R. Hogg, moved the adoption of the directors' report. The chairman stated that the working expenses, in spite of increased wages to the staff, had been reduced from 61·19 per cent. of the gross takings in the previous year to 56·84 per cent. in the year under review. Traffic receipts and other sources of income yielded £31,729. After meeting all expenses, adding to rolling stock, allowing for depreciation, and providing for fixed debenture interest and prior lien bond sinking fund, there remained, including £217 brought forward, a balance of £2,396. From this amount it was proposed to take £1,751 for payment of 2½ per cent. on first income bonds, leaving a balance of £644 to be carried forward.

Hull Corporation Tramways.—Reviewing the estimated financial results of the current year, which terminates on March 25 next, the Lord Mayor, chairman of the Hull Corporation Tramways Committee, said that the traffic expenses had increased by about £7,000, and of this £6,000 was due to wages, half being accounted for by the committee making up the wages of the men who had enlisted, and the remaining £3,000 being taken by automatic increases. In general expenses there was a decrease of £2,200. The expenditure on repairs, including car maintenance, had been reduced by £8,850. It was estimated that there would be a decrease in receipts of £4,780, which left a net balance for the year of £11,587; adding £3,736 due for interest on investments, the surplus was £15,323. The Lord Mayor proposed that out of the surplus a grant of £10,000 should be given in relief of rates, the balance to be carried to the reserve fund.

(*Continued on page 194.*)

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TRAMWAY AND OMNIBUS SHARE LIST.

Specially Compiled for "The Tramway and Railway World."

Amount Ranking for Dividend.	Shares.	Name.	Div'd. Prev. Half-year.	Div'd. Last Half-year.	Quotations, Mar. 5.	Movement Since Feb. 4. Rise.	Movement Since Feb. 4. Fall.	Latest Business Done. Price.	Latest Business Done. Date.	Yield on Buying Price. £ s. d.	Dividend Due. (Final in Italics.)	Quotations, Jan., 1908, to Mar. 5, 1915. Highest	Quotations, Jan., 1908, to Mar. 5, 1915. Lowest
$6,000,000	$100	Alabama Traction 5% Bonds	5	5	51—53	+ 2	...	53½	Feb. 5	...	Mar., Sept.	86	49
640,000	5	Anglo-Argentine Tramways 5½% Cum. 1st Pref.	2/9	2/9	4—4½	...	— ⅛	85/–	Mar. 1	6 9 6	Jan., July.	5½	4
500,000	5	Do. do. 5½% Cum. 2nd Pref.	2/9	2/9	3½—4	...	— ¼	74/6	Mar. 3	6 17 6	June, *Dec.*	5½	3½
1,500,000£	...	Do. do. 5% Deb. Stock Red.	5%	5%	86—88	...	— 1	87⅜	Mar. 5	5 13 9	June, Dec.	105½	86
325,532£	Stk.	Auckland Elec. Trys. Co. 5% Mort. Deb.	5%	5%	96—99	...	...	96½	Mar. 1	5 1 0	Jan., July.	107	96
75,000	1	Bath Electric Tramways 5% Cum. Pref.	6d.	6d.	⅜—⅝	...	...	11/–	July 29	8 17 9	*Jan. & July*	⅝	7/16
334,696£	Stk.	Birmingham Dist. Pow. & Tract. 4½% 1st Deb....	4½%	4½%	82½—85½	...	...	83	Jan. 15	5 7 9	Jan., July.	96	77
15,000	10	Blackpool and Fleetwood Tramways	4/-	9/-	12 -13	...	— ½	13⅛	June 29	5 0 0	Feb., Aug.	16	12
60,000	10	Bombay Elec. Supply & Trys. Co. 6% Cum. Pref.	6/-	6/-	10⅛—11	...	— ⅛	10 5/16	Feb. 19	5 9 3	Feb., Aug.	12	7⅞
1,003,614	$100	Brazil Traction...	6%	6%	49—51	...	— 9	52	Mar. 5	12 1 3	Fb.My Ag.Nv.	105½	49
75,000	5	Brisbane Elec. Tramways Investment Co. Ord.	4/-	4/-	6¾—7½	...	...	7	Mar. 4	5 10 6	*May*, Oct.	9½	5 5/16
75,000	5	Do. do. do. 5% Cum. Pref.	2/6	2/6	4¾—5	...	— ⅛	4 15/16	Feb. 9	5 0 0	*May*, Nov.	5⅞	4⅜
50,000	10	Bristol Tramways and Carriage Co.	5	4	5⅛—5⅜	...	— ⅛	6⅛	Mar. 3	8 3 9	*Feb.*, Aug.	14½	5
50,000	10	Do. do. do. 4% Cum. Pref.	4	4	7—7½	...	— ⅛	6¾	Feb. 24	5 10 6	Jan., July.	9¼	6⅜
800,000£	Stk.	British Columbia Electric Railway Def. Ord.	8⅜	...	69—71	...	— 21	70	Feb. 16	11 5 3	May, Nov.	156	69
800,000£	Stk	Do. do. Pref. Ord.	6⅜	6⅜	69—71	...	— 20	69¾	Feb. 25	7 1 0	Feb., Aug.	132⅛	69
800,000£	Stk	Do. do. 5% Cum. Perp. Pref.	5%	5%	85—88	...	— 9	87½	Feb. 26	5 13 9	Jan., July.	114	86
1,070,097£	Stk.	British Electric Traction 6% Prefd. Ord.	...	...	10—15	...	...	10	Feb. 10	...	Apr., *Oct.*	19	8
403,503£	Stk.	Do. do. 6% Cum. Pref.	6%	6%	73—76	...	— 4	75	Jan. 8	7 18 0	Feb., *Aug.*	95⅛	73
1,464,245£	Stk.	Do. do. 5% Perp. Deb.	5%	5%	86—88	...	— 3	86⅜	Feb. 25	5 15 0	April, Oct.	101	82½
439,796£	Stk.	Do. do. 4½% 2nd Deb. Red.	4½%	4½%	70—75	...	...	77¼	June 17	6 1 9	May, Nov.	84	58
246,625£	Stk.	Buenos Aires Port & City Trys. 6% 1st Mt. Deb.	6%	6%	68—73	...	...	71	Mar. 24/14	...	Feb., Aug.	103	61
623,270£	Stk.	Buenos Ayres Lacroze Trys. Stg. 5% 1st Mt. Deb.	5%	5%	99—101	...	...	100½	Feb. 2	5 0 0	Mar., Sept.	103	89
137,610	5	Calcutta Tramways Ord.	7/–	3/–	6—6½	...	— ⅛	7¼	Feb. 19	7 14 0	*Apr.*, Oct.	7⅜	4
47,295	5	Do. 5% Cum. Pref.	2/6	2/6	4⅛—4¼	...	— ⅛	4⅛	Jan. 25	5 5 3	Jan., July	5⅜	4⅛
491,222	1	Cape Electric Tramways	6d.	for yr.	⅜—½	...	...	14/–	July 18	3 6 9	Feb., *Nov.*	1/16	⅜
15,000	10	Carthagena and Herrerias Steam Tramways	4/-	May, '14	2¾—3½	...	...	62/6	Mar. 3/14	5 14 3	April.	7	2⅜
248,000	5	City of Buenos Ayres Tramways (1904)	2/6	2/6	5—5½	+ ⅛	...	5 3/16	Feb. 24	4 15 3	Fe Mv Au No	6	4⅛
120,000£	Stk.	Colombo Elec. Trys. & Ltg. 5% 1st Mt. Deb.	5%	5%	93—97	+ 2	...	93	July 6	5 4 3	May, Nov.	101	87
11,500	10	Cork Electric Tramways and Lighting Co.	...	6/- ann.	4—4½	...	...	4 4/5	Dec. 23	6 13 6	*Mar.*	10	4
12,327	10	Do. do. do. 5% Cum Pref.	5/-	5/-	6½—7	...	...	6⅝	Feb. 26	7 3 0	Jan., July	10⅜	6½
3,000	10	Dublin and Lucan Elec. Railway 5% Cum. Pref.	5/-	Nil	6—7	...	...	9	Aug. 25/10	..	Sep.15, Mar.15	9¼	6
60,000	10	Dublin United Tramways Co. (1896), Ltd., Ord.	5/-	5/-	10¼—10¾	...	— ½	£10 1 6	Feb. 19	4 13 0	Feb., Aug.	14	10 1/16
60,000	10	Do. do. do. 6% Cum. Pref.	6/-	6/-	12—12¼	...	...	12¼	Mar. 3	4 18 0	*Feb.*, Aug.	14	11½
268,235	10/-	Hastings and District Elec. Trys Ord.	...	...	½—⅝	...	...	1/3	April 17	...	...	⅝	½
80,000	1	Do. do. 6% Cum. Pref.	6%	6%	⅝—¾	+ 1/32	...	10/9	April 17	8 6 9	...	⅝	1/2
125,000£	Stk.	Do. do. 4½% Deb. Stk. Red.	4½	4½	65—70	...	...	65	April 15	6 8 9	April, Oct.	100	65
$9,634,000	$1,000	Havana Elec. Rly. Co. Con. Mort. 5%	5%	5%	87—90	...	...	88½	Jan. 14	5 13 9	Feb., Aug.	105	80
195,000£	100	Hong Kong Tramways Co. 5% Mt. Deb.	5%	5%	85—90	+ 2½	...	82½	July 29	5 12 6	May, Nov.	92	75½
20,000	10	Imperial Tramways Ord.	Nil	4% year	3⅜—3⅝	...	...	3	Mar. 4	11 0 9	Feb., Aug.	9¾	2½
20,000	10	Do. 6% Cum. Pref.	6%	6%	6¼—6½	...	...	6 7/32	Ju. 28/09	9 4 9	Jan., July.	9¾	2¾
30,000	5	Isle of Thanet Elec. Try. & Ltg. Co. 5% Cum. Pref.	3/–	Dec. '13	1¾—2	...	— ½	37/6	Feb. 25	7 10 0	*Mar.*, Sept.	3	0¾
170,000	1	La Plata Elec. Trys. Co. 6% Cum. Pref.	7/16d.	...	⅜—⅝	...	...	17/–	Oct. 14	...	*April*, Oct.	1 1/16	0½
30,800	10	Lanarkshire Tramways	6/6	6/–	9¾—10	...	— ¼	£9 16 6	Feb. 27	5 15 0	Feb., Aug.	10⅜	9⅜
250,000£	Stk.	Lancashire United Trys. 5% Prior Lien Deb....	5%	5%	84½—86½	...	...	87½	June 15	5 15 9	Jan., July.	95	76
634,026	1	Lisbon Electric Tramways Ord.	7/16d	7/16d.	1 1/16—1 3/16	...	— ⅛	25/–	June 30	5 1 3	*July.*	1½	⅝
425,553	1	Do. do. 6% Cum. Pref	7/16d.	7/16d.	⅝—1	...	— ⅛	21/–	June 5	6 0 0	Jan., July.	1½	11/16
1,833,136	1	London and Suburban Traction Ord.	1/16d.	...	3/16—¼	...	— 1/32	4/6	Jan. 16	...	...	5/9	3/9
1,581,059	1	Do. do. do. 5% Cum. Pref.	5	5	1/16—3/16	...	— 1/16	9/–	Feb. 25	8 17 9	Feb., Aug.	14/–	9/–
1,000,000£	Stk.	London General Omnibus 4½% 1st Deb.	4½	4½	95—99	...	...	98½	Mar. 5	4 11 0	Jan., July.	98½	92¼
1,000,000£	Stk.	Do. do. 5% Cum. Income	5	5	83—85	...	— 4	86¼	Mar. 5	5 17 9	Feb., Aug.	95	84
1,649,930£	Stk.	London United Tramways 4% 1st Deb. Stk.	4	4	53—57	...	...	54	Mar. 4	7 0 6	*Jan.*, July.	82	54
63,430£	Stk.	Madras Elec. Trys. (1904) Ltd. 5% Deb. Red.	5%	5%	99—101	...	...	101½	Oct. 16	4 19 0	Jan., July.	105	86
20,000	5	Do. Do. Do. 6% Cum. Pref.	6%	6%	4½—4¾	...	— ⅜	92.6	Feb. 9	6 6 6	Ma., Sept.	5⅜	87/6
300,000£	100	Manaos Trys. & Ltg. Co. 5% 1st Debs.	5%	5%	69—71	...	...	70	Feb. 2	7 1 0	Jan., July.	97	69
$4.785,000	$1.000	Manila Elec. R. R. and Ltg. Corp. 5% Gld. Bds.	5%	5%	95—100	...	...	100½	June 10	5 3 9	Mar., Sept.	104⅜	84
60,000	1	Mansfield & District Trys. Ltd. 6% Cum. Pref.	7½d.	7½d.	1⅛—1 1/16	...	...	20/3	Jan. 1	5 13 0	Mar., Sept.	1 1/16	¾
$20,000,000	$100	Mexico Tramways Common Stock	$1¾	Nov. '13	34—39	...	— 6	30	Mar. 2	...	Fb.My.Au.No	151⅛	34½
$3,840,000	...	Michigan Untd Rys. Co. 5% 1st Debs & Refdg Bds	5%	5%	90—92	...	...	90½	July 6	5 8 9	May, Nov.	101½	89⅛
600,000£	100	Montreal Street Rly. 4½% Ster. Debs.	4½%	4½%	102—104	+ 3	...	99½	Jan. 16	4 11 0	Fe.My.Au.No.	107	97
150,000	1	National Steam Car	5%	year	1/16—1/16	+ 1/16	...	12/3	Mar. 5	7 5 6	Dec.	39/9	8/9
50,000	1	Oldham, Ashton, and Hyde Elec. Tramways Ord.	6 year	Nil	13/– —14/–	+ 1/–	...	14/–	Apr.2/13	...	Mar., Aug.	18/9	11/6
50,000	1	Do. do. do. 5% Cum. Pref.	5%	5%	13/– —14/–	...	— 1/–	14/6	Jan. 9	7 3 0	Feb., Aug.	17/–	12/4½
77,893	5	Para Elec. Rly. and Ltg. Co., Ord.	5/–	..	4—4½	...	...	4 1/16	June 10	6 13 6	May, Nov.	8	4
245,000	1	Potteries Electric Traction Ord.	3½	for '13	3/32—1/32	...	...	7/6	May 6	8 12 6	April.	⅜	⅛
245,000	1	Do. do. 5% Cum. Pref.	6d.	6d.	⅜—½	+ 3/32	...	10/9	Mar. 4	8 0 0	*Feb.*, Aug.	⅜	1/16
124,560	1	Provincial Tramways Ord.	8d.	10d.	1/16—1/8	...	...	17 4½	Jan. 18	8 0 0	May. *Nov.*	1 1/16	13/–
10,000	10	Do. do. 6% Cum. Pref.	6/-	6/–	10—10½	...	— ⅜	10	Mar. 3	5 17 3	June, *Dec.*	11	9
50,000	5	Rangoon Elec. Trys. & Supply Co. 6% Cum. Pref.	3/-	3/-	5—5⅛	+ ⅛	...	5 1/16	July 11	5 9 3	June, Dec.	6	4⅜
32,000	10	Shanghai Elec. Construction Co.	14/-	year	12½—13½	...	...	12¼	June 27	5 3 9	May.	13 1/16	6
330,400£	Stk.	Singapore Elec. Trys. Ltd., 5% Debs. Red.	5%	5%	88—92	...	...	89	April 2	5 8 9	Mar., Sept.	92	61
91,720£	Stk.	Southern Elec. Trys. of B.A., 1st Mt. Deb.	5%	5%	97—100	...	— 1	99½	Jan. 22	5 0 0	Feb., Aug.	102	90
471,500£	100	Toronto Rly. Co. 1st Mt. 4½% Stg. Bonds	4½%	4½%	94—95	...	— ½	94½	Jan. 15	4 14 9	Feb., Aug.	104	94½
80,000	5	United Elec. Tramways of Monte Video, Ord....	4/-	2/-	4½—4¾	+ ¼	...	98/9	May 19	6 6 6	*June*, Dec.	6½	4½
90,000	5	Do. do. do. 6% Cum. Pref.	3/-	3/-	4⅝—5⅛	...	...	4 13/16	June 19	5 14 3	June, Dec.	6⅝	4 5/16
500,000£	Stk.	Winnipeg Elec. Rly. Co. 4½% Perp. Cons. Debs.	4½%	4½%	89—92	...	— 1	90½	Mar. 5	4 18 0	Apr., Oct.	109½	89
40,977	5	Yorkshire (West Riding) Elec. Trys. Ord.	...	...	⅛—⅜	...	...	96/6	Jan. 26	...	*Mar.*	1⅛	⅛
46,261	5	Do. do. do. 6% Cum. Pref.	2/6	3/–	4⅛—4⅜	+ ⅛	...	90/–	Mar. 5	6 9 9	*Mar.*	4⅜	1¼

ELECTRIC RAILWAY STOCKS.

1,854,720£	Stk.	Central London Ord. Stock (4% Guar.)	4	4	75—77	...	— 1	77½	Feb. 19	5 4 0	*Feb.*, Aug.	89½	59¾
572,640£	Stk.	Do 4% Guar. Pref. Stock	4	4	76—78	...	— 4	79	Mar. 5	5 2 0	Feb., Aug.	92	74½
572,640£	Stk.	Do. Deferred Stock (4% Guar.)	4	4	73—75	...	— 3	74½	Mar. 4	5 6 9	Feb., Aug.	91⅜	42
50,000	10	Liverpool Overhead Ord.	2/6	3/6	4 1/16—4 3/16	...	— 3/16	4 1/16	Feb. 2	6 19 3	*Feb.*, Aug.	4½	⅜
1,412,263£	Stk.	Mersey Cons. Ord. Stock	Nil	Nil	3½—3¾	...	— 1½	6	June 11	...	*Feb.*, Aug.	8	1
5,732,062£	Stk.	Metropolitan Cons.	1⅜	1⅜	28¼—29½	...	— 2	29	Mar. 5	4 6 3	*Feb.*, Aug.	75⅜	28½
2,640,914£	Stk.	Do. Surplus Lands Stock	2¼	2¼	57—60	...	— 1	57⅝	Mar. 1	4 11 9	*Feb.*, Aug.	72	56⅜
3,235,000£	Stk.	Metropolitan District Ord.	Nil	Nil	17—19	+ ⅜	...	17	Mar. 5	...	*Feb.*, Aug.	51⅜	9½
500,000	10	Underground Electric Railways Co. of London	...	...	1¾—2	...	...	32/6	Mar. 5	...	...	5 3/16	1⅜
1,730,000£	...	Do. 4½% Bonds of 1933	4½%	4½%	99—102	+ 2	...	100½	Mar. 5	4 8 3	Jan., July	102	73
1,192,707£	...	Do. 6% 1st Income Debs.	6%	6%	109—111	...	— 4	112	Mar. 5	5 8 3	Mar., Sept.	118	108
6,120,750£	Stk.	Do. 6% Income Bonds	60/-	60/-	82—84	...	...	80½	Mar. 5	7 8 0	Mar., Sept.	97⅛	18
1,150,477	1/–	Do. "A" Ord.	...	...	⅛—3/16	...	...	5/6	Feb. 26	...	...	17/6	3/9

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Lancashire United Tramways.—The report of the Lancashire United Tramways, Limited, for the year 1914 states that the combined undertakings show a profit of £26,474. Traffic receipts were higher than those of the previous year by £3,472, notwithstanding a reduction of £1,880 since the beginning of the war. Additional expenses occasioned by the working of extensions and motor coaches, heavy cost of permanent way maintenance, and higher rates of pay to employees had increased the expenditure for the year to the amount of £4,651. After deducting interest on prior lien debenture stock and expenses, there remains the sum of £158, which has been carried to depreciation account. There is also an undivided surplus on the year's working of the operating companies after payment of interest and dividends, amounting to £13,816. Depreciation and renewal accounts in the combined companies, with sums carried forward, now amount to £38,743.

The Tyneside Tramways and Tramroads Company.—The report of this company for the half-year ended December 31, 1914, which was briefly referred to in our issue of February 6, shows that the surplus of receipts over expenses amounted to £6,185, and including the balance brought forward of £1,060 there was a total of £7,245. After deducting interest on debentures, loans, etc., amounting to £1,004, there remains an available balance of £6,241. A dividend of 5 per cent. on the preference shares and 3 per cent. on the ordinary shares was declared, £1,400 was carried to renewals, etc., account, and £1,500 was carried to the special reserve account to meet contingencies, leaving a balance of £731 to be carried forward. The dividend on the ordinary shares is an increase of one-quarter per cent. as compared with the dividend for the previous year. The following statement gives a comparison of the company's operations for the past three years:

	1912.	1913.	1914.
Car-miles (Tyneside Tramway Company's cars)...	717,567	720,286	724,097
Passengers carried (Tyneside Tramway Company's lines)	5,619,201	5,959,691	6,749,161
Total traffic receipts	£26,888	£28,569	£31,819
Gross profit	£9,456	£9,795	£12,988

Paisley District Tramways Company.—In the report submitted to the shareholders, the directors state the results of the company's working up to December 31, 1914, as follows: Revenue, £61,998 19s. 1d.; expenditure, £47,663 8s. 5d., including general interest, interest on debentures, etc.; profit, £14,335, which, with £2,866 brought forward, leaves a balance of £17,200. Of this amount £4,500 has been placed to general reserve account; £3,750 has been paid for the dividend for the half-year to June 30 on the 5 per cent. cumulative preference shares; £1,000 placed to the preference share sinking fund for the half-year to June 30; and the directors recommend that the balance be disposed of as follows: £3,750 to dividend for the half-year to December 31 on the 5 per cent. cumulative preference shares; and £1,000 to preference share sinking fund; leaving £3,200 to be carried forward. The traffic receipts show a decrease for the year of £845. For the first six months of the year there was an increase of £777, but owing to the outbreak of the war, for the second six months there was a decrease of £1,622. Considering the circumstances, the directors regard the traffic receipts as satisfactory. The amount spent on the maintenance of the track and roadway is again very heavy and larger than in the previous year, but the condition of the track is much improved. The directors regret that the profits will not allow of any dividend on the ordinary shares.

Newcastle Tramways and Relief of Rates.—The Tramways Committee of Newcastle Corporation have issued their estimates of income and expenditure for the coming year. The committee put the total income at £282,200, and the expenditure at £160,300. The estimated gross surplus is therefore £121,900. From this sum, £75,000 for interest and redemption must be provided, and other requirements, including £8,000 to be paid dependents of employees on active service, reduce the surplus to £31,400. At the beginning of the year the reserve fund stood at £94,000, or £6,000 short of the £100,000 the committee consider should be maintained. During the past 12 months upwards of £15,000 more has been spent out of the reserve fund for renewals, so that the depletion of the fund will be nearly £22,000. It is hoped, however, that the deficiency will be made up by the surplus on the present year's working of the system. During the ensuing 12 months it is estimated that £34,000 will have to be spent for the renewals in lines and machinery. It will thus be seen that the whole of the estimated profit of £31,000 would be required to build up the reserve fund to its proper level. Notwithstanding this, the Tramways Committee is strongly disposed to giving £18,000 to obviate an increase in the rates of the city. At a meeting of the City Council, held on February 24, Sir Walter Plummer moved that the sum of £20,000 be deducted from the funds of the Tramways Committee in relief of rates. Sir William Stephenson suggested that the matter should first be considered by the Finance Committee, and on that understanding the motion was withdrawn.

The Railway Association.—At a meeting at the House of Commons on March 8, Mr. Evelyn Cecil, M.P., Sir Frederick Banbury, M.P., and Colonel Mark Lockwood, M.P., were nominated as members of the Council of the Railway Association.

THE PURCHASE PRICE OF BRISTOL TRAMWAYS.

Sir George White presided at the general meeting of the shareholders of the Bristol Tramways and Carriage Company, held on Monday, February 22, at the Grand Hotel, Bristol, when the report for the year ended December 31, 1914, was presented. The statement of accounts showed that the expenditure had been as follows: Traffic expenses, £174,622; general expenses, £58,947; renewals and repairs, £138,615; total, £372,185. Income: Tramway department, £239,651; carriage department, £209,512; sundry receipts, £5,610; total, £454,774. From the net revenue of £82,589, the following amounts have been distributed: Interest on 4 per cent. mortgage debenture stock, and 4½ per cent. mortgage debenture, etc., £30,637 15s. 6d.; interest on proceeds of investments (carried to reserve fund), £4,467 15s. 3d.; dividend on 4 per cent. preference shares, £18,458 6s. 8d.; interim dividend at the rate of 4 per cent. for half-year ending June 30, 1914, £9,395 16s. 8d. The balance of £19,629 11s. 9d. is to be appropriated as follows: Final dividend for half-year at the rate of 5 per cent. per annum, making 4½ per cent. for the whole year, £11,328 2s. 6d.; reserve fund, £8,301 9s. 3d. The receipts from the tramway department show a decrease of £4,035, or 1 65 per cent. for the year, while the receipts of the carriage department have increased £34,811, or 19 92 per cent. The total number of passengers carried during the year was 58,301,585, as compared with 56,790,300 in the previous year, an increase of 1,511,276.

In moving adoption of the directors' report, Sir George reviewed at length the details of the balance sheet, but the most important part of his speech was a statement on the question of the purchase of the tramways undertaking by Bristol Corporation. The proceedings of the Corporation in Parliament, he said, involved the unremitting attention of the directors to safeguard the interests of the shareholders. Parliament had given the protection sought, and now, if the Corporation elect to purchase, they must acquire the whole of the company's tramways and light railways undertakings, both within and without the city. The portions upon which the Corporation had no option must, under the conditions imposed by Parliament, be purchased with due allowance for computed profits over varying periods up to 32 years from the present time. In the event of resort being had to arbitration, the shareholders of the company had nothing to fear. The expert adviser of the Ratepayers' Committee, opposed to the purchase, had estimated that the Corporation would have to pay at least £1,215,000; but the advisers of the company were assured, after careful analysis of the assets, that arbitration would give them hundreds of thousands of pounds more than any of the figures hazarded by outsiders. In proof of his contention, Sir George showed that there had been a very large increase all round upon the prices paid when the main outlays of the company were made, and arbitration proceeded upon the basis of the values ruling at the moment. He quoted the report of the Corporation advisers, dated July, 1913, as follows:

> "The method of assessing the 'then value' of any tramways is generally arrived at by the following proceedure. The cost of replacing the tramways at or about the date of the purchase by the Corporation is first ascertained, regard being had to the then costs of materials and labour. No regard is had, of course, to the amount that it did actually cost the company to construct, which may have been more or less than the cost of replacement at the time of notice to purchase. The replacement cost being thus ascertained, it is then necessary to proceed to depreciate it to its probable value in May, 1915."

Saying that he had no quarrel with this exposition of the principle upon which the Corporation have to purchase, Sir George went on to deal with the question of depreciation, quoting the suggestion of the Corporation's advisers of 35 per cent., and repudiating it as totally inapplicable to the company's property, the tramways and cars having been lately renewed and the buildings and plant being almost as good as new. Summing up the various items to be taken into account in valuation, the chairman assessed the value of the undertaking to be purchased at over two millions sterling. He ridiculed the motion put forward by some of the Corporation's advisers that the undertaking could be purchased for £670,000, and said "if they can secure it at that price, they will buy the cheapest property in the kingdom." The Corporation were free to determine their own course, however, and it was not for him to presume to advise them. When the arbitration was completed, they would see which of them had been gifted with prescience. Near the close of his speech, however, Sir George admitted the possibility of negotiation with the Corporation and settlement of the question. The Option Committee of the Corporation had invited the directors of the company to a conference, and though they had deferred decision, it was probable, in view of the fact that the Corporation must soon give notice if they intend to purchase, that they would meet the Option Committee and try to come to an agreement. But he said that if the unpractical views of which they had heard so much during the past year still influenced the committee of the Corporation, the arrangement of any *modus vivendi* was impossible. "And I go further," Sir George declared, "and add that, from a monetary point of view, the shareholders must stand to gain from an immediate sale, as we can certainly use the Corporation money to give us a better return than we are obtaining from the working of the tramways."

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	*May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington	*Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne	*Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1914	Sept., 1901	,,	9 30	...	...	...	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham	*Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn	*Mar. 25, 1914	Mar., 1899	,,	24 63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool	*Mar. 31, 1914	June, 1899	,,	(p) 21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	*Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,032	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford	*Mar. 31 1914	July, 1898	,,	(h) 106 29	1,280,788	1,061,115	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	*Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	*Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	*Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1914	June, 1903	,,	21 2 (b) 13 21	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l) 29,518	69,745	335	70,080
Chester	*Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield	*Mar 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester	*Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	*Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington	*Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	*Mar. 31, 1914	July, 1904	E.	22 20	...	...	...	245,332	11,026	177,676	67,656	(l) 32,356	E 51,126	1,048	52,174
			H.		...	...	...	...	...	...	...	...	H 429	19	448
Doncaster	*Mar 31, 1914	June, 1902	E.	12 58	...	...	..	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham	*Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	*Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester	*Mar 31, 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	*Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	*Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	*Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	*Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock	*May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy	*May 15. 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster	*Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	*May 15. 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	*Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool	Dec. 31, 1913	Nov., 1898	E.	119 0	...	...	...	2,024,706	17,014	1,177,384	1,091,771	428,318	677,881	13,018	690,899
Lowestoft	*Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone	*Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester	*Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	*Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	*Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham	*Mar. 31, 1914	Jan., 1901	,,	...	...	...	...	667,705	...	410,091	237,501	68,372	172,731	2,648	175,379
Oldham	*Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth	*Mar. 31, 1914	Sept., 1899	,,	15 0	...	...	...	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall	*Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	*Mar. 31, 1914	May, 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham	*Mar. 31, 1914	Jan., 1903	,,	12 2	...	183,775	...	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	*Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton	*Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport	*Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields	*Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l) 26,881	37,744	586	38,330
Staly'ge, H., M., D.	*Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport	*Mar. 31, 1914	Aug., 1901	,,	27 5	...	...	...	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland	*Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey	*Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31. 1913	Dec., 1902	,,	19 44	188,145	188,100	45	183,351	9,378	159,561	58,366	33,873	32,991	682	33,673
Walthamstow	*Mar 31. 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington	*Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham	*Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	*Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	*Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)	*Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	*Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1914	Nov., 1905	E.	98 54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	*Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	*Mar. 31. 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth	*Mar. 31. 1914	July, 1902	,,	(e) 29 62	432,440	...	...	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	*Mar. 31. 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry	*Mar. 31. 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1914	Oct., 1898	,,	193 40 (b) 2 53	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
Huddersfield	*Mar. 31. 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	*Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	*Mar. 31. 19 4	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester	Dec. 31. 1913	May, 1904	,,	37 0	929,120	727,405	201,715	739,982	19,999	602,478	129,807	100,000	147,458	17,059	164,517
London	*Mar. 31, 1914	...	H.	13 73									21,145	480	21,635
		May, 1903	C.E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	*Mar. 31. 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton	*Mar. 31. 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth	*Mar. 31. 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	*Mar. 31. 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	*Mar. 25, 1914	Sep., 1899	,,	79 3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	*Mar. 31. 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Additional lines leased and worked. (e) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1½ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses. Traffic.	General.	Repairs & Maintenance.	Power.	Total.	Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit. Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	Net Surplus + or Deficit −
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	35,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	..	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,432	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	180,226	61,361	84,026	121,185	446,798	244,101	24,220	48,971	60,318	...	(d) 54,163	e) 4,869	168,321	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RTI ,310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(k) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,294	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,019	3,201	4,678	5,710	21,608	12,065	1,371	5,191	3,439	458	1,868	...	10,956	+ 2,480
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(c) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,005
Leicester	54,257	10,405	21,566	23,887	110,115	54,402	3,763	23,541	12,453	2,122	7,636	2,413	48,165	+ 10,000
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(t) 18,079	784,349	− 88,526
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses.
(n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account.
(r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit motor char-a-banc. (z) Includes £6,519 rent of leased lines. † £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Costs).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	..	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	4,011	...	...	14·08	13·46	3·41	·97	2·93	2·06	9·37	66·10	7·37	1,901,668	1·3	1·64
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·38	10·26	2·315	·769	1·213	1·252	5·549	50·44	4·297	2,037,620	1	1·252
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·038	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	449	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E. 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	..	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·34	12·10	3·217	1·096	1·500	2·164	7·977	63·2	5·813	23,928,396	1·138	1·78
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	7,013	24,000	...	11·87	3·04	1·04	1·34	1·92	7·34	61·82	5·42	5,359,804	1·25	1·51
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale... ...	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ... R.T ...	4,287 1,009	750 ...	12·54 10·74	12·52 10·74	2·92 2·44	·87 ·76	2·22 2·68	2·79 1·23	8·80 7·11	70·15 66·20	6·01 5·88	1,731,184 120,303	1·375 1·375	2·03 1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport ...	...	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	1,480	...	1,000	11·234	11·007	2·675	1·068	1·561	1·905	7·209	64	5·304	845,654	1·68	1·176
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1⅞	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester... ...	...	...	10,000	9·801	8·785	3·232	·620	1·285	1·423	6·560	66	5·137	7,141,333	·411	1·77
London	...	...	...	E. 9·21 H. 8·15	8·94 7·97	3·32 4·07	·76 1·39	1·41 1·53	1·01 4·40	6·50 11·39	70·55 139·72	5·49 11·39	154,048,461 ...	·601 ...	2·63 ...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30,581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·08

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		*d.*	*Miles.*	*d.*	*Miles.*			
Aberdeen	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10 3	·508	1·80	·58	7·5	703	54	77
Accrington	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13.1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190.	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11.1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,244	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn	200,000	1,149,462	12,731,532	11·07	1·28	63·15	105	2,751	6·10	·88	1·28	·76	7·5	448	32	61
Blackpool	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24.9	·73	...	...	8	...	34	78
Bolton	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford	370,000	6,258,878	67,675,166	10·816	1·058	182	113	2,792	16 2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8 2	·86	1·27	·788	6·41	544	34	50
Burnley	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·28	·83	7	874	46	67
Burton	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6 3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10 10	·543	1·24	·85	8·51	483·83	45·26	54
Chester	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6·7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5 5	·78	1·38	·75	7·33	126	7	17
Colchester	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4·8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9·10	·871	2·05	·50	8·14	942·23	59	75
Darlington	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby	124,000	E 1,208,880 H. 17,710	12,136,148 110,231	10·039 6·224	1·011 ·935	97·88	...	2,398	8/3	·67 1·35	1·44 1	·75 1	6·375	...	...	50 3
Doncaster	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8·2	·547	2	·50	7·3	...	...	68
East Ham	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12·4	·867	1·30	·87	7·23	853·93	77	101
Ilford	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,256	5/7	·62	1·543	·69	8	...	..	26
Ilkeston	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52.8	·8	1·80	·5	7	101	7	13
Ipswich	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley	43,000	242,500	3,099,272	12·8	·68	72·06	55·35	1,447	4.1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8·10	·475	1·522	·64	7	183	17	22
Lancaster	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6 8	·512	1·32	·72	8·3	314	21	37
Leyton	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6.11	·532	1·75	·428	7	90	5	8
Liverpool	839,000	13,442,605	144,085,927	10·72	1·129	172	77	5,695	16/2	·744	2·514	·39	7·5	4,920	480	595
Lowestoft	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19·3	·683	...	...	...	...	...	662
Nelson	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,843,669	40,535,874	11·43	1·02	155	92·72	...	13/2	·642	1·70	1	6·86	...	105	135
Oldham	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	..	...	6·25	120	8	12
Plymouth	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10·9	·751	1·12	·88	9	247·5	15	24
Rochdale	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham	64,000	E 852,639 RT 128,685	9,874,231 471,690	11·58 3·67	1·08 2·72	154·3	...	3,701	13/9	·76 1·92	...	...	...	...	...	...
Salford	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,843,941	13,162,224	8·52	1·23	108	77·38	3,624	11·1	·82	1·25	·55	...	...	...	70
Southend	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·68	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	...	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall	100,000	719,372	6,121,381	8·509	1·293	61	86	1,885	6/7	·847	1·24	·79	7	345	23	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	450	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·51	7·75	1,235	95	118
Wigan	200,000	1,500,846	14,295,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6·2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9·11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17 5	·824	1·19	·87	6·8	1,140	60	81
Cardiff	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,417	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6 4	·831	1·18	·866	6·4	476	40	46
Glasgow	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18.9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds	525,000	9,204,331	93,671,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester	230,970	4,028,542	37,073,717	9·202	·954	161	...	3,985	12·9	·712	2·18	·984	8	...	...	150
London	...	E58,572,356 H 636,933	516,338,859 613,781	8·82 10·38	1·01 ·77	...	120·18 77·12	7,866 1,519	... ...	·73 1·09	... ...	... ...	9·05 5·85	17,728·8 203·14	1,335 23	1,722 56
Newcastle	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	14·40	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6 4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16/1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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CONTRACTS AND ORDERS.

Hadfields, Limited, are to supply 17½ tons of tie bars to Sheffield Corporation.

Yarmouth Town Council have accepted the tender of John Baker and Company, Rotherham, for 60 steel tires.

Lion Foundry Company, Stockton Heath, have received an order for tramway shelters for Loughborough Corporation.

Dick, Kerr and Company, Limited, are supplying 10 tons of tramway rails to Dover Corporation at £8 15s. per ton.

Babcock and Wilcox, Limited, have an order for coal and ash conveying plant at £9,964 from the Leeds Corporation.

Messrs. Mossay and Company have an order for a 2½-ton Orwell electric tipping wagon for Birmingham Corporation.

Messrs. Durham, Churchill, and Company have an order for a 45-H.P. omnibus chassis at £650 from Sheffield Corporation.

The Daimler Company have an order from Walsall Tramways Committee for six motor omnibuses for the tramways department at £5,369.

Edgar Allen and Company, Limited, have an order from Manchester Tramways Committee for permanent way points, tongues, and hardened steel centres.

The Otis Elevator Company, Limited, have an order from the Glasgow Tramways Committee for a new goods elevator for use in the extension of the head office.

W. A. Stevens, Limited, of Maidstone, have received an order from the Bradford Tramways Committee for a 40-H.P. petrol-electric tower wagon chassis at £672.

Siemens Brothers Dynamo Works, Limited, have an order for three motors of 10 H.P. each required for the new workshops of the Hull Corporation Tramways.

Jarrah Blocks for Tramway Track.—Maidstone Town Council have sanctioned the purchase of 25,000 second-hand Jarrah wood blocks, for use on tramway track in High Street.

The British Insulated and Helsby Cables, Limited, have received an order from Manchester Electricity Committee for cables and for copper to be made up into cables.

British Westinghouse Electric and Manufacturing Company's tender for electrical equipment of six cars and trucks has been accepted by the Plymouth Tramways Committee.

Brush Electrical Engineering Company's tender for supply of six cars and trucks, at £470 per car, has been recommended for acceptance by the Plymouth Tramways Committee.

J. H. Tucker and Company have an order from Newport (Mon.) Electricity and Tramways Department for electrical accessories, including switches, required for the next 12 months.

The Booth Steamship Company have accepted the tender of the Edison and Swan United Electric Light Company, Limited, for Royal Ediswan metal filament and carbon filament lamps.

Manchester Tramways Committee have accepted the following tenders: Permanent way special trackwork, Hadfields, Limited; Titan Trackwork Company, Limited; and the Lorain Steel Company.

The General Electric Company, Limited, have an order from the Bibby line of steamers for Osram lamps. This contract covers a very large quantity of lamps, and was placed after exhaustive tests of various types of lamps.

The Manchester Electricity Committee have given an order to Bruce Peebles and Company, Limited, for one 500-KW. additional motor converter; and to Johnson and Phillips, Limited, for two 500-KW. additional transformers.

The Llandudno Council have given an order to the Electric Construction Company, Limited, for a dynamo, and to Messrs. Browett, Lindley, and Company, for an engine for the municipal electric lighting station.

The Peckham Truck and Engineering Company, Limited, of Queen Anne's Chambers, Westminster, S.W., have recently received repeat orders from Doncaster, Sheffield, Reading, and Derby Corporations, and from Dublin United Tramways Company.

The British Thomson-Houston Company's tender for the supply and erection of a 3,000-KW. turbo-alternator at £8,170, and a 6,000-KW. turbo-alternator and condenser at £16,560 for Crown Point power-station, has been accepted by the Leeds Corporation.

York Electricity and Tramways Committee have recommended the acceptance of the tender of the Brush Electrical and Engineering Company for six double-deck cars at a price of £507 10s. each; also the tender of the British Thomson-Houston Company, Limited, for electrical equipment of these cars at £304 each.

Glasgow Tramways Committee have recommended acceptance of the following tenders: Trolley cord, W. C. Yuille and Company, Limited; special trackwork, Lorain Steel Company, Titan Trackwork Company, Limited, and Edgar Allen and Company, Limited; three-core cable, British Insulated and Helsby Cables, Limited.

Liverpool Tramways.—The following orders have been placed: W. Scott, Limited, Leeds Steel Works, Leeds, 2,500 tons Sandberg silicon steel tramway rails, 131 lb. per lineal yard; 300 tons ditto, 139 lb. per lineal yard for curves; 40 tons fish plates (royalty to be paid to Mr. C. Sandberg); Hadfields, Limited, Sheffield, 100 tons tie bars.

Edison Vehicles.—The Edison Accumulators, Limited, of Duke Street, London, S.W., are supplying four electric omnibus chassis to West Bromwich Corporation for £3,560. The same firm have received an additional order from Messrs. Harrods, Limited, for 18 ½-ton Edison battery commercial vehicles, making a total of 46 vehicles ordered to date by Messrs. Harrods.

Leeds Tramways and Electricty Committee have accepted the following tenders: Supply and erection of switch gear at the electricity works, the British Westinghouse Electric and Manufacturing Company, Limited, £4,800; supply and erection of an electrically-driven overhead travelling crane, Isles, Limited, £1,945; coal and ash-conveying plant, Babcock and Wilcox, Limited, £9,964; supply and erection of a 6,000-KW. turbo-alternator and condensing plant, British Thomson-Houston Company, Limited, £16,560; supply and erection of a 3,000-KW. turbo-alternator for Crown Point power-station, British Thomson-Houston Company, Limited, £8,170.

The York Electricity and Tramways Committee have recommended acceptance of the following tenders: For the supply, etc., of a forced-draught cooling tower, etc., the Worthington Pump Company, Limited, £2,126; for the alteration and improvement of the switchboard at the electricity works, the British Thomson-Houston Company, Limited, £176 10s. 6d.; for the supply of specially-designed switch gear required in connection with the charging of batteries for the electric 'buses, the British Thomson-Houston Company, Limited, £80 per set for each of two boosters; for the supply of poles for overhead tramway work, Tramway Supplies, Limited, £555 11s. 8d.

London County Council have placed the following orders:

Siemens Brothers Dynamo Works, Limited, for the repair of two armatures belonging to 500-KW. motor generators.

Hadfields, Limited, for special trackwork at Balham car shed.

Messrs. Y. J. Lovell and Sons, for the provision of accommodation for motor lorries at the Leven Road, Poplar, and the Leighton Road, Kentish Town, permanent way depots, £2,157.

Charles Wall, Limited, for additions and alterations to the coal bunkers at Greenwich generating station, £12,171 10s.

A. Roberts and Company, Limited, for the erection of an additional weather shelter at Blackfriars, £962.

The Acetylene Illuminating Company, Limited, for the supply of 12 rail joints for the tramways in Old Kent Road, at the rate of 21s. a joint.

Alldays and Onions, for two motor lorries at £972 8s. These vehicles are to replace two procured in January, 1913, and purchased by the War Department on the outbreak of war for £780.

The Morgan Crucible Company, Limited, for carbon brushes at a cost, based on the total estimated quantity, of £56 3s. 4d.

HALFPENNY FARES REJECTED AT BOURNEMOUTH.

At a recent meeting of the Bournemouth Council a report was presented by Mr. I. Bulfin, general manager, on the question of halfpenny fares, the introduction of which, he said, would have a disastrous result. It was a recognised fact that it was impossible to fix a common scale of fares which would apply equally to all towns. Each system had special local conditions. The southern counties were very seriously handicapped in regard to costs, and this necessitated very much higher earnings per car-mile than in some other districts. One of the chief points to be considered in fixing fares was the density of population per mile of tramway route. The higher the density the greater the revenue and the greater chance of introducing cheaper fares with financial success. What might be done with success in such towns as Glasgow and Hull, for instance, where there was a great density of population per mile of route, could not be attempted in smaller towns. Some of these, in trying to emulate larger and more densely populated towns, fell into the error of granting too cheap fares, with the result that the undertakings have been, and still are, financial failures. Once fares were reduced it was a very difficult matter indeed to raise them. The density of population of the Bournemouth tramway system was only some 4,000 per mile of route, and under such conditions halfpenny fares would mean disaster. In conclusion, Mr. Bulfin said: "In view of the facts I am absolutely opposed to halfpenny fares in any form for the Bournemouth system, and I am perfectly certain that if the Tramways Committee are so ill-advised as to introduce them, the results to the undertaking would be financial ruin." The Council declined to make any alteration in the fares.

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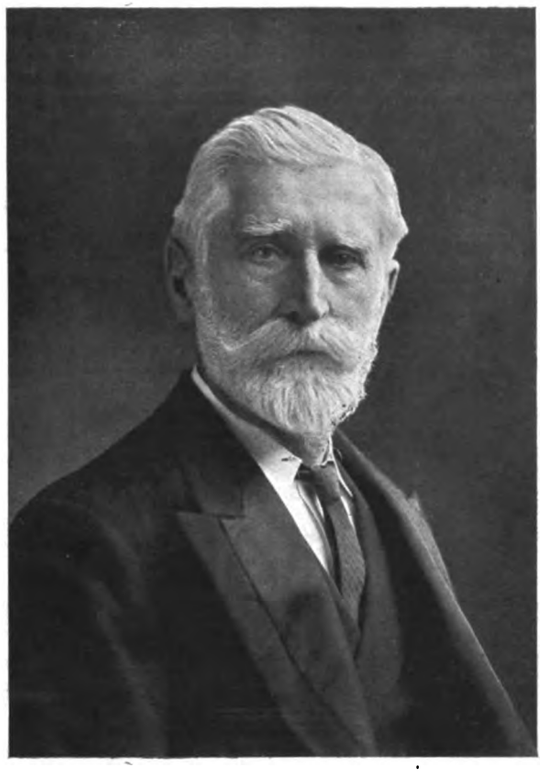
PRESENTATION TO MR. W. M. MURPHY.

Mr Wm. M. Murphy, chairman of the Dublin United Tramways, was presented on Thursday, February 4, with a life-size portrait of himself and an address, the latter bearing the signatures of 410 gentlemen representative of trade, commerce, and professions, not only in Dublin but throughout the country. This public tribute took place at the Dublin Chamber of Commerce in the presence of a large gathering, and was made in recognition of the great services rendered by Mr. Murphy to the industrial development of the city during the many years that he has been identified with it. It will be recalled that during the two years that Mr. Murphy was president of the Chamber of Commerce, 1912 and 1913, he had to face a serious crisis which threatened the commercial prosperity of Dublin, if not, indeed, of the country. How he rescued the community from the syndicalist tyranny from which it had suffered is still fresh in the minds of the public. The text of the address is as follows:

"The citizens of Dublin desire to express to you their appreciation of the great services you have rendered to the industrial development of the city during the many years that you have been identified with it. The numerous successful commercial enterprises which you have organised bear testimony to your ability, and have been of enormous benefit to the community.



Mr. W. M. Murphy.

"The tramways service which you gave us is unsurpassed in the world. In the press you have provided the citizens with the latest benefits in modern journalism. As chairman of the International Exhibition held in Dublin, your skill and untiring energy ensured the popularity of that undertaking, which brought such a vast number of people to the city and so benefited the traders.

"During the past two years that you have been president of the Dublin Chamber of Commerce you have done good work for the benefit of trade and commerce.

"When the recent labour troubles in Dublin arose the stand taken by the companies which you presided over, and your services on the Employers' Executive Committee saved the city from a peril that threatened to destroy the industrial enterprises of the metropolis, as well as the rest of the country.

"The subscribers to the address, in recognition of your services, desire to present you with the accompanying portrait of yourself executed by the eminent Irish portrait painter, Mr. William Orpen, R.A. They trust that you will receive this as a small expression of the great esteem and regard in which you are held, not only by the commercial community, but also by many others with whom you have been brought in contact.

"A replica of this portrait has been executed under the supervision of the artist, in which you are invested with the very handsome gold chain and badge which you presented to the Chamber of Commerce, to be worn by the president of the Chamber for the time being. This replica will be hung in the room of the Chamber of Commerce as a lasting record of your efforts to promote the interests of your fellow-citizens of the commercial community of Dublin."

Mr. Murphy, in acknowledging the presentation, said that with whatever humility he might look back on his career he could not deny himself the pleasure of thinking that he must possess some merits to account for the remarkable list of names appended to the address. There was one thing he would claim for himself—namely, that any part he had taken in the public life of Dublin had been free from self-seeking; and he was inclined to think that it was a recognition of this fact more than anything else that accounted for the 400 signatures of distinguished men and leading firms to an appreciation of his services, of which any citizen might feel justly proud. The commercial undertakings with which he had been associated were embarked upon primarily with the object of making profit, but he might claim that that had never been his leading idea in the various undertakings that he had projected. To achieve something and to overcome obstacles in reaching his goal had always had a more stimulating effect on him than mere profit seeking. To him and to many others, though they perhaps did not think of it in that light, the game of business and the striving towards success in commerce is more fascinating than any form of sport. He had proved that an Irishman, making his head-quarters and spending his life in his native land, was not handicapped to such an extent as to prevent him from successfully extending his interests to Great Britain and abroad. It was very difficult to express one's real feelings, but he would be very callous indeed if he did not feel deeply the very signal compliment that had been conferred upon him.

PERSONAL.

Mr. A. Jarratt, of Islington, has been appointed mains superintendent of the Swansea electricity department.

Mr. A. P. Quilliam, assistant tramway engineer of Huddersfield Corporation Tramways, has been granted an increase in salary.

Mr. E. H. Hoggard, of the Sheffield Corporation Tramways, has been appointed traffic superintendent of the Darlington Corporation Tramways.

Mr. H. Webber has received an increase in salary to £400 as borough electrical engineer of Keighley. Mr. Webber has an additional salary as tramways manager.

Mr. R. L. McCulloch, of the Warwick and Leamington Tramway Company, has been appointed general manager of the City of Carlisle Electric Tramways Company, Limited.

Mr. J. C. Williams has been appointed deputy borough electrical engineer and tramways manager at Erith, in succession to Mr. Coveney, who recently accepted another appointment.

Mr. E. G. Izod, according to a South African contemporary, has succeeded Mr. J. H. Rider as head of the engineering staff of the Central Mining Rand Mines group. Mr. Rider, as mentioned in a previous issue, has joined the firm of Messrs. Preece, Cardew, and Snell.

Mr. R. Barry Cole has resigned his position as sales manager to Commercial Cars, Limited, to take up an appointment as director and sales manager to Scottish Commercial Cars, Limited. The connection will not be broken, however, as the latter company are the sole agents for Commercial Cars, Limited, in Scotland.

Sergeant James M'Kenna, of the 1st Gordon Highlanders, is among those who have been recommended by Sir John French for the distinguished conduct medal. Before he was called up, M'Kenna was in the Glasgow Corporation Tramways service. He is the second tramwayman to receive this honour, the first being, as mentioned in our issue of February 11, Mr. Hugh Irwin, a sergeant in the Northumberland Hussars, and an official of the Newcastle Corporation Tramways.

New Appointments on the Great Northern Railway.—The following new appointments have been made on the Great Northern Railway: Mr. J. E. Abbott and Mr. A. Lamb have been appointed assistants to Mr. C. J. Selway, the superintendent of the line. Mr. Abbott's duties lie in the control of the working of the passenger, goods, and mineral traffic, and those of Mr. Lamb in matters of staff, special traffics, rules and regulations, and the general commercial business of the department.

Private Lonsdale.—According to a Reuter's telegram from Amsterdam, the sentence of death on the British prisoner of war, Private Lonsdale, has been commuted by the German Imperial Military Court to 20 years' imprisonment. It will be remembered that Private Lonsdale was formerly a tramway conductor at Leeds. He was captured and sent to the prisoners' camp at Doberitz, in Germany. He was sentenced to death on the charge of striking a guard at the camp, and appealed.

Army Commission for a Tramway Conductor.—Mr. Andrew Nance, general manager of the Belfast Tramways, forwarded to the motormen and conductors serving with the Expeditionary Force the

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annual bonus awarded for careful driving, accuracy in cash accounts, and good conduct, and in return received a letter from Corporal Gill, lately a conductor, saying that Conductor R. Philpotts, serving in the R.F.A., had been promoted to commissioned rank for service in the field. It is noted that Mr. Philpotts obtained last year's highest place in the Belfast tramway service for accuracy in his cash and daily reports.

Private B. J. R. Lilley, of the 1st Battalion Royal Fusiliers, formerly employed as a tramcar driver by West Ham Corporation, was killed in action on January 22.

Mr. C. E. Stretton.—The death occurred on February 20, at Leicester, of Mr. Clement Edwin Stretton, a well-known railway consulting engineer, aged 65. Mr. Stretton made a special study of the safe working of railways. He was at times consulted by railway companies when the causes of railway accidents were investigated, and interested himself particularly in precautions for safeguarding railway workers' lives. He represented England in the railway department of the Chicago Exhibition in 1893, and prepared the English collection.

Mr. F. W. Lawson, of Leeds, whose death occurred at Bath on February 24, was a well-known figure in the engineering industry of the West Riding. He had been in failing health for some time, but continued in harness as long as his health would allow, and the news of his death was unexpected. He was a director of Messrs. Fairbairn, Lawson, Combe, Barbour (Limited), of which his brother, Sir Arthur Lawson, Bart., is chairman. He was an excellent linguist, and travelled much on the Continent in the interests of his firm. In 1895 he entered the Leeds City Council, and it was under his chairmanship of the Works Management Committee that the tramway system was converted to electric traction. To the Works Committee was entrusted the task of installing the new system, and Mr. Lawson's advice greatly helped to bring about the success which was soon attained. In 1900-01 Mr. Lawson was chosen Lord Mayor of Leeds. As an employer of labour he took considerable interest in the welfare of young men of the city, and was at the head of a local committee which had for its object the diversion of young boys from what are called "blind alley" employments into more profitable paths.

Mr. Arthur Keen, chairman of Guest, Keen, and Nettlefold, Limited, whose death occurred at Edgbaston, Birmingham, early in February, entered the railway service after leaving school. Mr. Keen subsequently resigned a railway appointment to join Mr. Watkins in the exploitation of what was then a new American patent for making bolts and rivets. Mr. Keen's inexhaustible energy and commercial ability made the Patent Nut and Bolt Company one of the principal business concerns in the Midlands, and by judicious amalgamations the firm attained a foremost position among the industrial organisations of the world. Until his last illness compelled him to desist, Mr. Keen remained at the head of the vast business, controlling five millions of capital and employing close on 50,000 workers. As chairman of the London City and Midland Bank, he was a prominent figure in banking circles, taking an influential part in bringing about the amalgamation of the Sheffield Union Bank with the Yorkshire Banking Company. Mr. Keen was greatly in favour of Tariff Reform, and was a member of Mr. Chamberlain's famous Tariff Reform Commission. He also took a deep interest in the foundation and development of Birmingham University.

Iron and Steel Institute.—The annual meeting will be held at the Institution of Civil Engineers on May 13 and 14, and the annual dinner is provisionally fixed for May 13. It is probable that the autumn meeting will be held in London in September.

Tramway and Light Railway Association.—The Council of this association have decided to postpone the annual meeting and dinner, which it was proposed to hold in June, to a later date, of which due notice will be given. The annual election of new members of the Council in place of those to retire by rotation will be deferred until the general meeting.

Manchester Corporation Tramway Employees' Social and Athletic Society.—The report of this society for 1914 has just been issued, and it shows a pleasing prosperity both financially and socially. The total income was £1,304, and the expenditure £1,196, giving a surplus of about £108. Sports in the shape of football, cricket, bowling, hockey, swimming, and fishing are fostered by the society for the benefit of the tramway employees, and debating classes, concerts, choirs, and other recreations organised by the members. Instigated by Mr. McElroy, the general manager of the Corporation Tramways Department, the members of the Social and Athletic Society have entertained, on two occasions, the wives, mothers, and children of the employees of the department who have joined the army. On the first occasion, held on February 11, 1,300 guests were entertained. At the second gathering, attended by 1,450 persons, young and old, a photograph of the wives, mothers, and children of those on active service was taken, a copy of which will be sent to the men at the front and a copy given to the relatives at home.

TRAMWAY AND LIGHT RAILWAY NOTES.

ABERDEEN.

P-A-Y-E Cars to be Continued.

The Tramways Committee, after further discussion of the pay-as-you-enter cars, decided to postpone until July a decision as to whether the system should be adopted over the whole of the routes. A 12 months' trial will then have been completed. It will be recollected that Mr. R. S. Pilcher, the general manager, in a recent report strongly advised the retention of the pay-as-you-enter system, contending that it had been successful in every respect.

ASHTON-UNDER-LYNE.

Application for an Increase in Wages.

The drivers and conductors of the Ashton, Oldham, and Hyde Tramways, the Stalybridge Joint Tramways Board, and the Ashton Corporation Tramways have made an application for an increase of 1d. per hour in wages for all grades.

BIRMINGHAM.

Children's Tickets.

The Birmingham and Midland Tramways Company have decided to introduce children's tickets at half-fares on the tramways from Smethwick and Oldbury to Dudley. The company have also been approached by the Rowley Regis Urban District Council to obtain a similar concession on the Black Heath and Old Hill route.

BOLTON.

Appeal for Higher Wages—Jumping Off a Moving Car.

Bolton Corporation Tramways Committee have received an application from the branch secretary of the Amalgamated Association of Tramway and Vehicle Workers, who requested them to grant an advance of a penny per hour to motormen, conductors, overhaulers, cleaners, and day labourers. The committee were also asked to receive a deputation in support of the men's application. The matter was referred to the General Purposes Committee.—The need for more attention to what has been called the "safety first" movement was again illustrated at Bolton Coroner's Court recently, when an inquest was held on the body of Joshua Dutton, who had been run over by a motor car as he was alighting from a tramcar, receiving injuries from which he died. In his evidence, the conductor of the tramcar stated that he warned the deceased against leaving the car while it was in motion, and advised him to wait till the next stopping place. Dutton insisted on getting off, however, and the conductor pulled the cord; but before the car could be brought to a standstill Dutton jumped off and fell in the roadway. At the same moment a motor car came along the street and ran over the prostrate man, the car driver being unable to pull up in time to avoid him. Accidental death was the verdict of the jury.

BRADFORD.

New Trackless Route.

At the meeting of the Bradford Tramways Committee held on February 21 the general manager, Mr. C. J. Spencer, reported that the equipment of the trackless trolley route from Foster Square to Bolton Woods was completed. As soon as the route is approved by the Board of Trade it will be opened to the public.

BRISTOL.

Skidding of a Tramcar.

A rather unusual accident formed the subject of inquiry at the Bristol Coroner's Court early in February. Joseph Stonner, a carter, was killed through collision of his cart with a tramcar. In answer to the coroner, the driver of the car stated that, on seeing the cart in front of him in the middle of the road, he struck the gong, put on the brake, and as the cart was not clear, applied the brake still harder. The wheels, however, skidded, and he put down sand and put the electric and hand brakes full on; but before the car, which was on an incline, came to a standstill, it had struck the cart. The horse fell, and the man, who was leading the horse, was knocked over and jammed between the wheel of the cart and the kerb of the pavement. A verdict of accidental death was returned by the jury.

BURY.

Tramway Extensions.

The extensions of the tramway system which the Bury Corporation began last year at Limefield and Jericho have now been completed. The Jericho section has been extended to the borough boundary, a matter of about 700 yards, and the Walmersley route has been extended as far as the New Inn, about 1,100 yards from the Limefield terminus. In connection with the latter system a great improvement in the road at Pigslee Brow has been effected. The road, which went through the hollow, has been raised about 11 ft., which will make it easier for both vehicular traffic and pedestrians. The rails have been welded, and smooth running of the cars has thus been secured.

DERBY.

Lowered Lights.

The chief constable of Derby has received instructions from the military authorities that lights on all tramcars are to be darkened, and that powerful head lights on motor cars or other vehicles are to be extinguished when passing through the streets of the town.

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DONCASTER.

Extensions Opened.

Extensions to the tramways aggregating one and a quarter miles in length have been opened. The permanent way and road widening have cost £8,000, and the overhead equipment and cables £1,500. Additions have also been made to the electricity works at a cost of £21,000, bringing the total expenditure on that installation to £100,000. Lieut.-Colonel Druitt, of the Board of Trade, who inspected the new tramway line, accompanied by Mr. E. S. Rayner, general manager, and representatives of the Doncaster Rural District Council, expressed his satisfaction with the work. Councillor Stirling, chairman of the Electricity and Tramways Committee, describing the recent extensions, said that the aim of the Corporation was to give a cheap and reliable supply of power and thus to add another to the already great attractions of Doncaster as a site for works. The Corporation were now in a position to cope with any demands for power that would be made to the borough for some years to come. The work of the extensions has been carried out under the direction of their own engineer, Mr. Rayner.

DUBLIN.

Damages for Personal Injuries.

Dublin United Tramways Company was sued in the King's Bench Division, Dublin, before Justice Gibson and a special jury, by Mrs. Vivien de Burgh Fosbery, for £4,000 damages, in respect of personal injuries alleged to have been caused by the negligence of the company's servants. Evidence showed that a lorry had been left in Leinster Road, with the shafts down, and that the lady had fallen over the shafts, though there was a lamp on the lorry. The jury returned a verdict for the plaintiff, and assessed damages at £1,100. A stay of execution was granted the defendants, who contended that the damages were excessive.

EDINBURGH.

Self-Propelled Cars—Opposition to Women Conductors.

On the motion of Councillor Deas, the Tramway Committee of Edinburgh Town Council appointed a sub-committee to consider details affecting the working of the undertaking. The sub-committee reports a recommendation that experiments be made with self-propelled cars on the existing cable-car system, with a view to the introduction of a system of self-propelled cars, either electrical or petrol.—Owing to the antagonism of the employees, the directors of the Edinburgh and District Tramways Company have decided not to employ women conductors as was proposed.

HALIFAX.

Tramway Bill Cut Down.

Halifax Corporation have not obtained consent of several local authorities to their Tramway Bill. In consequence, the Corporation appeared before the Standing Orders Committee of the House of Commons on Tuesday, February 23, asking that the Orders might be suspended and the bill allowed to proceed. Their Lordships allowed the bill to proceed to the Select Committee stage on condition that the proposed tramways in Brighouse, Hipperholme, and Sowerby Bridge were struck out.

HULL.

Halfpenny Stages and Free Travelling for Soldiers.

The Lord Mayor of Hull, commenting on the financial estimates of the Tramways Committee, stated that during the year new services had been opened out to Pickering Park, Springbank West, and Paragon Station, and halfpenny stages had been introduced, which meant an increase of the services on nearly all routes. It was estimated that the number of soldiers carried free of charge amounted to nearly 100,000 per week. Personally, the Lord Mayor had never regretted the carrying of soldiers free of charge. That the privilege was appreciated was shown by a letter which he had received from Lieut.-Col. H. R. Pease, whose battalion had just left Hull, thanking the committee for their concession.

KEIGHLEY.

A Profit of 2s. 6d.

The Keighley Town Council met on February 11 to consider the increase of 9d. in the £1 on the rates. A member of the Council suggested that if the Tramways Committee would hand over its surplus, the rates might be modified. In reply, Mr. Albert Smith, chairman of the Tramways Committee, pointed out that the realised surplus on the tramways for the current year amounted to 2s. 6d.

LEEDS.

Tramway Men Work Longer Hours—Heavy Road Traffic on Tramways.

Owing to the large number of Leeds tramway men now serving with the colours, and the consequent reduction of the staff, it has been found difficult to cope with the traffic on the 58-hours' week established by the wages agreement between the Corporation and the tramway men in August, 1911. Mr. J. B. Hamilton, the tramways manager, has consequently proposed to the members of the Tramway Men's Union that the terms of the agreement should be waived during the war, and that they should revert to the 60-hours' week, on condition that all time should be paid for when the "spread-over" of duty exceeds two hours of actual work. The employees have willingly agreed to the proposal.—Leeds Corporation has at present under consideration a scheme for dealing with heavy traffic by means of the tramways. The transit of heavy goods through the streets is very destructive of the granite setts It is proposed, therefore, that heavy loads should be carried on the tramways, as was done some time ago during the construction of a new reservoir, when the materials were hauled by the tramways and a considerable saving was effected. For this purpose a scheme has been planned for the construction of hopper wagons, to be drawn over the tramway lines by electric locomotives. The wagons are to have a carrying capacity of 10 tons each, and the charge is calculated to be about fourpence per ton-mile. It is not anticipated, however, that any scheme will be undertaken at present.

LONDON.

The Tramway Veto—Demand for Higher Wages—Removal of Centre Standards.

In the London County Council Tramways Bill there is a clause which caused the Metropolitan borough councils to threaten opposition on the ground that the Council was attempting to undermine the veto of the local authorities with regard to the system of traction to be used. The Council has now intimated that the objectionable clause will be modified and the threatened opposition has consequently disappeared.—The tramway men employed by the London County Council held a meeting at midnight on February 22 to consider the advisability of pressing for an increase of 15 per cent. in wages. The following resolution was passed: "That this meeting, representing all grades of tramway workers, in view of the enormous rise in the prices of the necessaries of life, hereby demand an increase of 15 per cent. on the present rate of wages for all grades of workers engaged on London County Council tramways."—Ealing Tramway Committee have recommended that the London United Tramways Company be requested to remove all the unlighted centre poles, 51 in number, and four centre poles carrying arc lights, leaving in their present positions 14 poles carrying arc lamps, and that refuges to an approved plan be constructed at the bases of the poles so retained, the Corporation agreeing to contribute £1,000 towards the cost of the removal of the poles and the construction of the refuges, the liability in connection with the posts carrying arc lamps, and the proposed refuges, to rest with the company.

MANCHESTER.

Twenty Years of Municipal Tramways.

Twenty years ago the Manchester City Council took the first step toward municipalising the tramway system and converting it to electric traction. A resolution was passed on February 20, 1895, appointing a special committee to report upon the proposed municipalisation. In 1898 the special committee became a tramways committee, and at its first meeting Mr. J. M. McElroy, then in the highways department of the Corporation, was appointed secretary and adviser to the committee. In 1900 he became general manager, and has continued since to manage the undertaking with marked success. The first step taken by the special committee was a recommendation to the Council to apply to Parliament for statutory powers. The recommendation was adopted, but as a result of a ratepayers' meeting the bill was withdrawn. In 1896-7, however, two bills were promoted, one by the Corporation and the other by the Tramways Company. Parliament threw out the company's bill, but passed the Corporation bill. Subsequently it was decided by the Corporation to purchase the undertaking and electrify the tramways. Negotiations followed with the Manchester Tramways and Carriage Company, and after arbitration and an appeal to the Law Courts an agreement was arranged out of court, the price being £335,000. The first lines were opened for electric traction in June, 1901. Several other routes followed and the entire electrified system passed into the hands of the Corporation in 1903.

OLDHAM.

A Conductor's Negligence.

A tramcar conductor's inattention to dilatory passengers has resulted in the Oldham Corporation being mulcted in damages to the extent of £75 and costs. At the Oldham County Court, on Thursday, February 18, a claim was brought by Mrs. Helen Hickey, a Rochdale resident, for £100 as damages for injuries sustained through the alleged negligence of a tramcar conductor on one of the Oldham Corporation cars. According to the statement of plaintiff's counsel, Mrs. Hickey and another woman journeyed from Summit to Oldham on the top of the tramcar. The car had been stopped at the Manchester Street crossing; the women were descending the steps to alight when the conductor, who was at the same time busy with the trolley pole, gave the signal to start. It started, and both women were thrown down on the car steps, Mrs. Hickey being injured. The conductor and the constable on point duty at the crossing both asserted that the women did not attempt to get off the car till after it had restarted. The judge, however, decided that negligence on the part of the conductor had been proved, and assessed the damages at £75 and costs.

PERTH.

Wages Raised.

The Tramways Committee of Perth Town Council have recommended that the maximum wage of tramcar drivers be raised from 28s. to 29s. per week. Owing to the number of men who have enlisted, it has been found necessary to employ lads under 19 years of age.

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PLYMOUTH.

THROUGH RUNNING.

The somewhat protracted negotiations for the through running of the cars of the Plymouth Corporation and the tramway companies are said to be approaching completion. The town clerk at a recent meeting of the Council stated that everything had been done with a view to bringing about the through running at the earliest possible date. There had been *pourparlers* with the Plymouth, Stonehouse, and Devonport Company and the Devonport and District Company, and he hoped that an arrangement would soon be reached.

SCARBOROUGH.

FIRE AT TRAMWAY DEPOT.

Damage, estimated at about £200, was done by fire at the Scarborough Tramway Depot, Scalby Road, on Saturday, February 13. When the Scarborough Fire Brigade arrived, about half-past three, they found a portion of the roof of the tram shed and workshops alight. A quantity of electrical apparatus was destroyed.

SOUTHAMPTON.

TRAMWAYS ENCOURAGE RECRUITING.

Tramway items of local importance were considered at the last meeting of Southampton Town Council. The Tramways Committee reported that a tramcar would be placed at the disposal of the military for two hours two days a week, for the use of a military band visiting the town to assist in recruiting. The committee had also resolved: "To recommend to the Council that authority be given to the committee to withdraw, when the committee in their judgment think it necessary, the concession made to the military and others of free travel on the tramcars."

TAUNTON.

TRAMWAY COMPANY'S LICENCES RESTRICTED.

The Streets and Highways Committee reported to Taunton Town Council that they had, on the application of the Taunton Electric Traction Company, granted renewed licences for the year. The borough surveyor, in reference to the complaints made of the noisy running of the cars, stated that the company had recently employed rail grinding to eliminate corrugations and reduce the noise in running. It was finally agreed that the licences be granted for only three months.

WEST HAM.

NEW CARS AND MOTORS RECOMMENDED.

Mr. J. S. D. Moffet, manager of the West Ham Corporation Tramways, has again reported to the Electric Lighting and Tramways Committee with reference to the necessity for obtaining new cars and the desirability of superseding the present electrical equipment with motors of higher power and efficiency. Mr. Moffett is confirmed in his opinion that the change should be made at once in order that the tramways may be in a position to meet the existing motor omnibus competition and the keener competition that will be encountered after the war. The importance of speed as a factor in modern passenger transport is pointed out, and the fact that the Board of Trade has increased the maximum speed allowed on practically every route in the borough is regarded as significant, as is also the admission of trailer cars for dealing with traffic during the rush hours. The present electrical equipment at West Ham is not capable of giving higher speed or hauling trailers. Mr. Moffet estimates the cost of new equipments at £28,000, and he proposes that £18,000 should be taken from the renewals fund and a loan obtained for the remaining £10,000. He estimates that the scheme would reduce the cost of running by not less than £3,240, equivalent to a return of about 12 per cent. on the capital outlay. Mr. Moffet states that he has obtained offers for car bodies and trucks, bringing the price to £1,145 per car, equal to an increase of about 15 per cent. on the prices current in 1912-13. He recommends the committee to accept the tender of the Brush Electrical Engineering Company for bodies and trucks, of the British Thomson-Houston Company for equipments and brakes, and of the British Westinghouse Company for controllers. The total cost for the 15 cars, including spares, will amount to £17,705.

YARMOUTH.

REDUCTION OF SERVICE.

A restricted service of trams has been brought into operation. The service on both the Yarmouth and Gorleston sections is reduced one-half. No cars will travel along the sea front after 5-30 p.m. until further notice. The services will start and close at the usual hours.

YORKSHIRE.

TRAMWAY MEN'S DEMANDS.

The Yorkshire District Council of the Amalgamated Association of Tramway and Vehicle Workers decided at a meeting held at Huddersfield to give strong support throughout the area of the Council to the Bradford circular, which is for an advance of 15 per cent. in the wages of tramway workers. The National Executive has approved the principle of the claim, and has already given permission to a number of branches to make certain applications analogous to it and in keeping with local conditions. The delegates to the meeting represented Sheffield, Leeds, Bradford, Halifax, and Huddersfield, and the same claim will be made for other areas employing large numbers of tramway workers. Such an advance is considered by the men to be more than justified by the greatly increased cost of living.

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(Patent),

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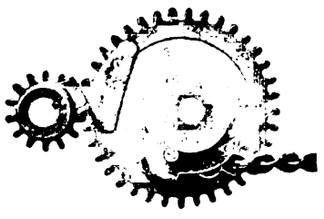

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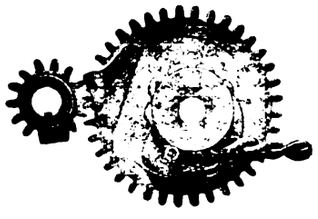

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SALFORD	428
METROPOLITAN	278
CROYDON	150
HASTINGS	130
WAKEFIELD	130
RHONDDA	108
NOTTINGHAM	100

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NEW AND PROSPECTIVE WORK.

Blackpool Corporation have decided to apply for sanction to borrow £675 for the purchase of four top-deck covers.

Maidstone Town Council have decided to install a 1,000-KW. Ljungstrom turbo-alternator at the electricity works.

The Railway Board propose to abandon the use of gas for train lighting and to equip all passenger trains with electric light.

A scheme for the establishment of a trackless trolley service between Middlesbrough, Grangetown, and South Bank has been formulated.

It is reported that the city of Durban intends shortly to call for tenders for the supply of material for the waterworks, electric lighting, tramway, and other undertakings.

Morecambe Town Council have determined to add to the attractions of the town by provision of a golf course, extension of the promenade, and the improvement and extension of the tramway lines.

Plymouth Tramways Committee have instructed the borough surveyor to invite tenders for new tram rails, with a view to the reconstruction of the track in the eastern section of Union Street as early as possible.

The Board of Trade have recently confirmed the London and North Western Railway (Dyserth and Newmarket Light Railway) Order, 1915, authorising the construction of a light railway in the County of Flint, from Dyserth to Newmarket.

Colwyn Bay Council have received the report that Abergele Road is ready for the laying of the electric tramway lines from Groes to the Marine Hotel. The lines will be completed and ready for traffic to the Queen's Hotel, Colwyn, in a few weeks.

The report of the L. and S.W. Railway Company for last year states that steady progress has been made with the electrification of the surburban lines, notwithstanding the exceptional difficulties. The central power-house at Wimbledon and sub-stations at other places are practically completed, and several of the new electric trains are ready for service.

At a conference between Wigan Town Council and Hindley District Council, the proposal of the latter that Wigan tramway lines should be extended along Hindley Market Street and up Castle Hill was discussed, but without terms being arranged. Negotiations have also been entered into with the South Lancashire Tramways Company for running powers over the Market Street lines.

In connection with the remaking of the roads rendered necessary by the removal of the tramway lines, the Oxford Highways Committee recommended that they should be empowered to advertise for and engage a superintendent of highways as an assistant to the city engineer, the person so appointed to have charge of the execution of all work required on the roads, the salary being fixed at £180, rising to £200 a year.

A Belfast company has entered into negotiations for the purpose of electrifying the Warrenpoint and Rostrevor tramways. These tramways, which were constructed under an Act obtained in 1876, and have been worked for the past 35 years, ceased operation on February 3. The lines were only 3¼ miles in length, and there were 12 cars, which were worked by horses. For the year ended December 31, 1914, there was a loss on the working of £92.

Extensions to Croydon Tramway Lines.—In the report submitted to Croydon Town Council by the borough surveyor and the tramways manager, the following proposals were made: (1) The extension of the terminal loop at the Addiscombe terminus, at an estimated cost of £845; (2) the construction of a new short loop at Havelock Road, estimated to cost £320; total, £1,165. Norwood Route—The extension of the passing place at the Gloucester in the direction of Selhurst and the construction of an additional passing place at Westbury Road, Northcote Road, would greatly facilitate the working of this route. The estimated cost of a new loop at Westbury Road is £320; extensions of loop at Gloucester, £200; total £520. Grand total estimated cost, £1,685. It was also proposed to lay a supplementary feeder from the Gloucester Box to the top of Tennison Road. The cost of laying a ·3 positive cable with two-way duct is estimated at £1,272 4s. 9d.

Drivers Fined for Excess Speed.—On February 11, four drivers of electric tramcars were summoned at the East Ham Police Court for exceeding the speed limits. According to the police evidence, it was shown that the accused drivers had journeyed at speeds ranging from 16 to 18 miles an hour. Three of the defendants were fined 30s. and costs; the fourth defendant was not convicted, but was ordered to pay the costs.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

1,601 Signalling devices—J. H. D. Blanke.
1,603 Signalling apparatus for use on railways—J. H. Pickles.
1,625 Trolley guide for electric trams—W. Barratt.
1,677 Brake—C. F. C. Wells.
1,680 Railway sleepers and rail ties—A. Bruce and A. Williams.
1,737 Vacuum brake apparatus—F. J. Gresham.
1,756 Vehicles for use in high-speed locomotion—F. Laur.
1,759 Railway vehicles—Leeds Forge Co., Ltd., and A. T. Houldcroft.
1,784 Change-speed gear of motor-driven vehicles—A. Dunnell.
1,799 Hydraulic transmission gear for motor vehicles S. R. Axford.
1,828 Life-guards for motor vehicles D. Walter and A. W. Lee.
1,835 Material for brake blocks H. Frood.
1,896 Electric lighting of railway carriages, etc.—H. Helin.
1,913 Trolley heads of electric tramcars—F. Kynman and F. Robson.
1,935 Means for automatic arrest of the movement of railway trains—W. R. Sykes, F. Downes, C. J. Cooke, and J. C. Sykes.
1,974 Signalling apparatus—J. B. Percival.
2,025 Railway signalling systems—P. J. Simmen.
2,030 Apparatus for actuating signals on trains and for stopping trains independently of drivers—G. G. Mathwin.
2,043 Central buffers and couplings for railway rolling stock—Edgar Allen and Company, Limited, and H. D. Boyd.
2,045 Electric accumulators—J. P. Haworth.
2,084 Road vehicle trains—F. Porsche, H. Reik, and Oesterreichische Daimler-Motoren Akt.-Ges.
2,133 Brake gear mechanism for tramcars—J. W. Gibson and J. H. Gibson.
2,149 Tramway rails—C. de V. Grant and Sir W. W. Williams.
2,254 Automatic train stop H. H. M. Shurlock.
2,255 Life-guard for vehicles—W. G. Moore.
2,267 Rain protector for motor omnibuses and tramcars—A. Ellis and P. Tonnellier.
2,268 Resilient connections used between the driving and the driven parts in motor or steam-driven vehicles—M. Hilton.
2,371 Side-splash mud guard for motor-propelled vehicles—J. M. Matthews and G. S. C. R. de Coverly.
2,404 Electro-magnetic driving mechanism—T. Rushton.
2,495 Railway signalling apparatus—A. F. Bound.
2,584 Sheathing for solid rubber tires—J. E. Blurton.
2,615 Device for automatically applying brake and preventing trains passing signals set at danger—L. Stones and W. C. Mower.
2,654 Laying tramway rails in roads—H. M. Worthington.
2,658 Automatic couplers for railway vehicles—A. W. Pimm.
2,681 Propulsive mechanism of motor-driven vehicles—J. MacDonald.
2,686 Jointing of tramway and railway rails by fish plates—H. F. Kerr
2,717 Switch-operating mechanism—J. L. Miller and I. C. Shaffer.
2,798 Gearing for electric motors for traction purposes—C. Turnbull, jun., and W. T. Dalton.
2,838 Brakes for tramway and railway vehicles—E. Hatton.
2,853 Car wheels and axles—J. W. McCoy.
2,897 Electric railway systems—F. G. Brettell *(C. W. Leffler)*.
3,032 Tramway rails—C. de V. Grant and Sir W. W. Williams.
3,134 Bogies for railway vehicles—A. Spencer.
3,144 Automatic signalling apparatus—A. P. Collier.
3,172 Signalling on railways and tramways—T. Forsyth.

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SPECIFICATIONS PUBLISHED.

1913.

28,080 Automatic train or vehicle braking—Prescott and Shand.
22,563 Apparatus for actuating signals on trains and for stopping trains independently of drivers—Parsons and Codd.
23,256 Transmission gear for motor vehicles—Hedges.
26,855 Electrically-controlled railway block signalling and apparatus therefor—Browne.
29,630 Buffers for railway vehicles—Spencer.
29,759 Electric railway systems—Stuart.
29,962 Railway brakes—Cheney.

1914.

5,447 Variable speed gears for use on motor road vehicles—Bowden Wire, Limited, and Larkin.
6,652 Composite trolley wheels—Taunton and Electro-Mechanical Brake Company.
6,895 Vacuum brake apparatus—Luard.
7,796 Life-guard for motor vehicles—Smith.
8,351 Chassis for motor road vehicles—Warren.
1,938 Crossings, points, turn-outs, etc.—Shimmin.
10,742 Electro-magnetic train stop—Doyle.
10,766 Motor road vehicles—Daimler Company and Berriman.
11,510 Railway signalling apparatus—Tyer & Co. and Stringer.
14,273 Buffers for tramway vehicles—A.B.C. Coupler, Limited, and Ingram.
15,588 Metal railway sleepers—Gover.
15,593 Devices for controlling railway points, etc.—Bell and Maguire.
1,297 Signalling devices for railways—Platt.
1,708 Stop-block apparatus—Barker and Berrisford.
1,759 Railway signalling—Jacobs.
2,528 Vehicular electric lighting systems—Renault.
2,827 Electric train lighting, ventilating, and heating systems—J. Stone and Company and Darker.
3,879 Motor road vehicles—D. Napier and Son and Rowledge.
9,011 Vacuum brake apparatus—Luard.
9,681 Railway chairs—McCurdy.
18,789 Means for securing railway rails to sleepers—Miller.
2,712 Rail joints—Stephenson.
4,813 Lighting and other auxiliary circuits on electrically-propelled vehicles—British Thomson-Houston Company *(General Electric Company)*.
6,612 Means for operating or controlling brakes, clutches, change-speed gearing, and other mechanism—Osborne and Osborne.
6,977 Overhead trolley wires—Glyn.
7,583 Automatic car couplers—Willison and National Malleable Castings Company.

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Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. Feb. 7.	Feb. 14.	Feb. 21.	Feb. 28.	1915. WEEKS ENDED. Feb. 6.	Feb. 13.	Feb. 20.	Feb. 27.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	56.665	58.466	55.561	56.516	50.295	51.560	47.578	50.712	8	402.907	– 52.212
Auckland	(28 days)	23.552	...	...	(28 days)	19.932	...	...	32	167.028	+ 7.938
Burma	...	4.181	4.047	4.053	...	3.577	3.727	3.466	—	—	– 34.302
Calcutta ... ... Rs.	67.046	67.952	66.874	69.418	65.571	65.424	63.919	64.755	9	5.76.535	– 40.127
Hong Kong ... ... $	11.382	11.327	19.757	10.527	9.941	12.612	13.042	17.606	9	101.515	– 13.526
Madras ... ... Rs.	(2 weeks) 28.738	(2 weeks)	23.055	...	(2 weeks) 27.430	(2 weeks)	23.683	...	8	1.08.499	– 1.433

Companies Issuing Monthly Statements.

	1913 Sept.	Oct.	Nov.	Dec.	1914. Jan.	Feb.	1914. Sept.	Oct.	Nov.	Dec.	1915. Jan.	Feb.	Wks.	AGGREGATE. 1915.	+ or –.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
BrazilianTraction Mlrs	6.028.078	6.098.850	6.009.487	6.142.209	...	...	6.096.940	6.241.170	5.929.730	6.010.490	...	...	52	73.351.478	+1.277.117
Brisbane	...	27.250	27.053	29.145	28.330	...	...	28.763	28.600	30.890	29.620	...	5	29.620	+ 1.290
British Columbia $	734.283	753.541	746.152	793.219	...	...	650.516	661.000	648.485	674.083	...	...	26	3.998.899	– 554.827
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	...	12.223	...	14.147	14.646	...	...	12.682	...	15.869	15.660	...	5	15.660	+ 1.014
Carthagena& Herrerias	1.344	1.582	1.922	2.698	2.776	2.919	2.175	1.543	1.379	1.255	904	1.822	9	2.726	– 2.969
Cordoba	13.343	13.278	...	12.863	...	...	12.384	12.919	...	12.119	...	...	39	119.457	– 845
East India	2.028	1.878	1.922	2.046	1.938	1.701	1.980	2.007	2.029	1.839	1.914	1.649	30	13.530	+ 12
Kalgoorlie	3.068	2.652	2.504	2.907	...	...	2.864	2.525	2.414	2.905	...	...	52	31.824	– 2.686
La Plata	4.528	4.920	5.409	5.505	5.296	...	4.190	4.540	4.540	4.452	4.540	...	5	4.540	– 756
Lima	34.177	35.175	33.236	38.091	37.870	...	28.786	30.648	29.749	32.112	33.042	...	5	33.042	– 7.870
Manila ... ... $	138.000	148.000	154.950	154.000	137.000	...	116.300	125.750	129.000	132.500	127.500	...	5	127.500	– 9.500
Melbourne	61.969	65.000	68.767	...	...	...	58.664	63.328	66.402	...	...	...	47	686.116	– 22.477
Mexico ... ... $	604.744	616.007	605.467	...	...	...	667.421	558.990	643.961	...	...	...	47	6.716.716	+ 378.911
Montevideo	...	...	30.531	33.310	38.256	...	...	...	27.081	28.605	32.443	...	13	88.129	– 728
Port Elizabeth ...	...	3.553	...	4.367	4.830	...	...	3.372	...	3.986	4.102	...	5	4.102	– 728
Puebla ... ... $	51.100	63.000	69.700	...	...	...	52.200	49.100	45.900	...	...	...	47	629.500	– 18.900
Rangoon	5.054	5.963	5.686	5.424	5.163	...	4.119	4.600	4.405	4.459	4.689	...	5	4.689	– 474
Toronto ... ... $	865.796	861.235	849.279	...	...	...	879.321	849.636	824.634	...	...	...	47	9.296.377	+ 402.393
Winnipeg ... $	331.732	357.313	360.082	379.863	...	...	310.996	330.562	330.398	368.400	...	...	52	4.101.302	+ 22.608

(*Continued on page 206*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	Feb. 7.	Feb. 14.	Feb. 21.	Feb. 28.	Feb. 6.	Feb. 13.	Feb. 20.	Feb. 27.	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1,459	1,473	1,431	1,474	1,509	1,507	1,564	1,550	39	64,247	+ 1,813
Accrington	545	559	564	546	443	493	487	519	47	25,006	- 2,071
Ayr Corporation	241	234	239	230	226	211	226	214	41	14,145	- 1,166
Bath Electric	727	733	729	734	623	648	585	612	8	5,025	- 569
Birkenhead Corporation	1,233	1,244	1,197	1,413	1,207	1,137	1,199	1,180	47½	59,681	- 2,311
Birmingham Corporation	12,285	12,673	12,576	12,423	12,267	11,923	12,257	12,140	48	582,280	+ 10,047
Blackburn Corporation	1,157	1,105	1,166	1,203	965	1,001	996	1,037	48	59,484	- 2,435
Blackpool and Fleetwood	337	275	284	290	346	278	283	291	8	2,444	+ 53
Blackpool Corporation	735	532	566	535	833	596	578	612	48	72,400	- 8,806
Bolton Corporation	2,577	2,706	2,550	2,606	2,493	2,426	2,568	2,394	48	128,476	- 2,571
Bournemouth Corporation	1,583	1,646	1,624	1,632	1,685	1,679	1,781	1,755	48	95,566	- 2,163
Bradford Corporation	5,854	6,266	5,702	5,818	5,553	5,981	5,710	5,618	48	293,172	+ 10,218
Brighton Corporation	796	795	784	871	787	766	801	768	47½	50,786	- 340
Bristol	7,543	7,236	7,519	7,206	8,436	7,980	8,250	8,189	8½	66,807	+ 6,111
Burnley Corporation	1,621	1,629	1,625	1,570	1,418	1,389	1,378	1,397	48	72,616	- 8,658
Burton-on-Trent Corporation	280	284	281	281	265	249	254	256	48	14,043	+ 72
Bury Corporation	1,288	1,302	1,249	1,289	1,172	1,104	1,213	1,151	47½	63,423	- 970
Cardiff Corporation	2,590	2,607	2,578	2,532	2,428	2,404	2,439	2,348	47	128,658	- 1,331
Chatham and District	836	805	830	797	946	973	931	955	8	7,548	+ 1,074
Chesterfield Corporation	258	260	257	253	236	235	232	239	47	12,545	+ 220
Colne Corporation	240	263	254	241	197	205	208	243	—	—	—
Cork Electric	445	459	453	442	420	426	440	408	8	3,408	- 168
Croydon Corporation	1,547	1,486	1,537	1,496	1,524	1,567	1,450	1,552	47	80,235	+ 2,472
Darlington Corporation	242	252	247	241	237	250	240	244	48	12,487	+ 535
Derby Corporation	951	978	943	928	903	875	903	873	47½	47,486	+ 567
Dover Corporation	...	192	192	193	...	238	235	237	49	12,149	+ 613
Dublin and Lucan	130	111	109	116	118	108	110	112	8	910	- 15
Dublin United	5,336	5,262	5,252	5,100	5,621	5,422	5,426	5,213	8	44,640	+ 2,713
Dundee City	1,244	1,248	1,247	1,203	1,178	1,199	1,196	1,173	40½	52,113	- 1,123
East Ham Corporation	1,048	1,032	1,024	1,000	1,267	1,254	1,202	1,213	47½	56,968	+ 8,383
Exeter Corporation	305	294	288	283	294	291	298	281	48	16,570	+ 432
Gearless Motor Buses	*	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	20,871	20,948	20,737	20,595	20,021	19,817	20,091	19,745	38	786,222	- 5,678
Glossop (Urban Elec. Supply Co.)	117	126	117	118	104	104	109	110	9	963	- 110
Halifax Corporation	1,913	1,961	1,992	1,986	1,897	1,892	1,904	1,957	47	101,990	+ 2,945
Hastings and District	711	711	714	744	664	718	670	732	8	5,576	+ 107
Huddersfield Corporation	2,090	2,158	2,200	2,170	2,227	2,174	2,272	2,246	48	132,431	+ 10,880
Hull Corporation	3,289	3,222	3,122	3,121	2,965	2,926	2,985	3,011	48	147,883	- 4,051
Ilford U.D. Council	432	435	428	435	562	558	548	540	47	27,336	+ 5,946
Ilkeston Corporation	120	127	122	126	111	112	113	115	48	6,072	- 358
Ipswich Corporation	367	355	360	366	295	327	358	352	48	21,109	- 364
Isle of Thanet	299	297	297	337	238	226	212	228	21	6,318	- 1,015
Kilmarnock Corporation	166	158	169	161	147	143	144	142	41	6,591	- 642
Lanarkshire	1,763	1,785	1,860	1,816	1,648	1,660	1,711	1,669	8	14,090	- 736
Lancashire United	1,592	1,519	1,544	1,521	1,459	1,495	1,467	1,533	8	11,928	- 170
Leeds City	8,107	8,131	7,940	8,181	7,925	7,632	7,987	7,935	48	393,410	+ 7,197
Leicester Corporation	2,832	2,808	2,743	2,784	2,747	2,733	2,768	2,765	9	23,286	+ 590
Leith Corporation	666	676	667	685	638	624	620	616	41	29,022	- 54
Leyton U. D. Council	...	...	...	...	...	...	...	...	—	—	—
Liverpool Corporation	12,707	12,902	12,381	12,715	12,639	11,940	12,213	12,131	8	102,596	- 2,384
Llandudno and Colwyn Bay	153	152	163	162	175	180	179	193	12	2,094	+ 262
London County Council	41,985	41,567	42,517	41,944	45,591	46,816	44,663	46,281	46	2,098,785	+ 109,029
London General Omnibus	*	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	179	154	151	154	147	145	143	141	21	3,571	- 331
Maidstone Corporation	171	159	171	162	152	157	148	155	48	9,611	+ 9
Manchester Corporation	17,095	17,335	17,087	17,262	16,428	15,841	16,481	16,223	48	818,277	- 18,042
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	180	202	188	211	141	152	158	177	47½	8,629	- 1,341
Newcastle-on-Tyne Corporation	5,200	5,012	4,916	4,940	5,621	5,660	5,611	5,566	48	264,904	+ 28,658
Newport (Mon.) Corporation	746	766	735	736	721	705	731	705	48	38,295	+ 1,497
New St. Helens and District	748	737	758	736	846	827	799	839	34	31,230	+ 3,042
Northampton Corporation	571	535	545	520	603	612	592	633	47½	28,433	+ 1,056
Nottingham Corporation	3,311	3,235	3,284	3,317	3,220	3,185	3,112	3,230	47½	160,798	+ 1,758
Oldham Corporation	2,179	2,155	2,131	2,118	2,001	1,900	1,995	2,000	49	104,958	- 2,889
Portsmouth Corporation	1,921	1,800	1,831	1,847	2,084	2,021	1,968	2,013	48	112,510	—
Preston Corporation	813	837	842	810	827	847	806	819	48	43,173	+ 1,002
Provincial	1,669	1,622	1,603	1,648	1,816	1,747	1,796	1,829	20	40,661	+ 4,159
Reading Corporation	651	654	669	629	643	657	634	659	47	33,332	+ 398
Rochdale Corporation	1,488	1,545	1,430	1,420	1,404	1,376	1,482	1,430	48	76,108	- 144
Rhondda Tramways	1,188	1,198	1,197	1,184	1,073	1,066	1,055	1,104	8	8,675	- 501
Rotherham Corporation	1,063	1,032	933	877	921	883	957	904	48	48,893	+ 214
Salford Corporation	5,047	5,137	5,125	5,053	4,582	4,528	4,694	4,449	47	236,339	- 13,626
Sheffield Corporation	7,859	7,699	7,738	7,657	7,844	7,603	8,133	7,763	48	378,081	+ 10,215
Southampton Corporation	1,177	1,183	1,205	1,151	1,160	1,196	1,132	1,193	47	62,087	+ 91
Southend-on-Sea Corporation	669	687	687	704	560	618	569	622	47	45,335	+ 1,427
South Metropolitan Tramways	*	...	...	...	...	...	...	...	—	—	—
South Shields Corporation	701	712	687	699	669	670	664	655	47½	35,809	+ 1,496
Sunderland Corporation	1,342	1,365	1,335	1,336	1,297	1,287	1,331	1,253	48	69,443	+ 353
Sunderland District	577	557	576	602	468	463	499	555	17	8,728	- 946
Swindon Corporation	144	159	158	159	152	164	156	168	47	8,410	+ 602
Torquay Tramways	412	405	412	422	357	373	390	427	8	3,125	+ 22
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	483	489	489	487	498	477	493	507	8	3,881	+ 150
Wallasey Corporation	1,099	1,109	1,066	1,093	1,048	995	1,034	1,012	47½	58,378	+ 563
Walsall Corporation	617	663	620	609	679	641	684	639	9	5,505	+ 325
Walthamstow U.D. Council	706	690	685	705	722	684	675	707	48	38,037	+ 2,720
Warrington Corporation	440	442	443	422	414	...	...	...	44	19,310	- 489
West Ham Corporation	2,648	2,670	2,690	2,627	2,729	2,775	2,659	2,773	47	133,638	+ 4,957
Wigan Corporation	1,504	1,451	1,489	1,439	1,366	1,373	1,346	1,396	47	68,726	- 2,132
Wolverhampton Corporation	1,040	1,071	1,009	1,016	980	951	968	987	49	50,651	- 1,662
Yorkshire (West Riding)	1,632	1,405	1,457	1,491	1,524	1,311	1,399	1,482	9	12,754	- 109

* Publication of Traffic Returns suspended during the war.

ELECTRIC RAILWAY TRAFFIC RETURNS.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

The directory is revised as occasion requires, and is the most up-to-date and comprehensive list published.

THE TRAMWAY AND RAILWAY WORLD

can be obtained, post free, at the following rates:

For the United Kingdom—
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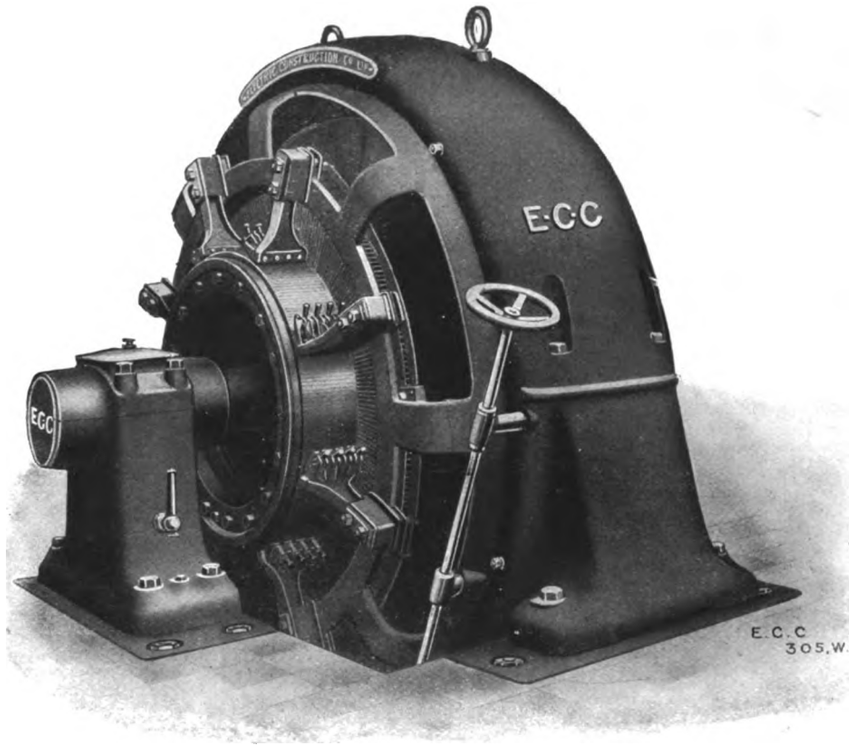

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Whilst the Company's Mills are running continuously day and night producing Dunlop Solid Tyres of Standard Sizes to fill the demands of the War Department and the principal chassis makers, users requiring for replacement old sizes not now standard, can have most old sizes at short notice. Immediate delivery can be given to users of all standard sizes.

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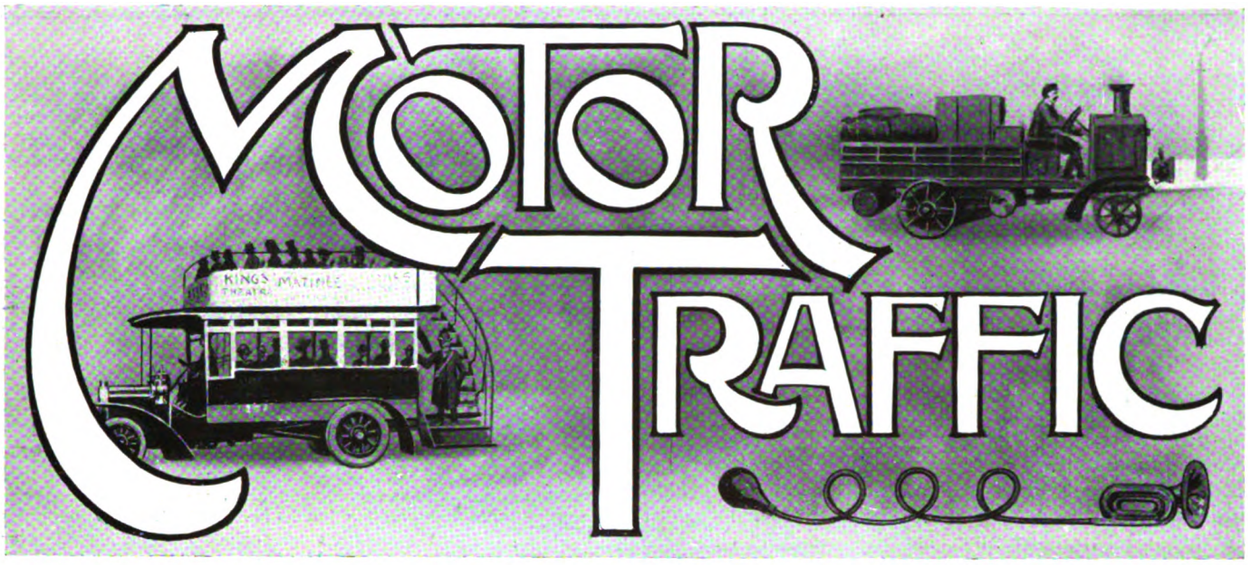

It is more than time that steps should be taken to see that all men who are licensed as drivers of motor vehicles should be possessed of fairly good eyesight. The conditions which these drivers have to fulfil before licences are granted to them are in many respects fairly onerous, and it seems peculiar that an eyesight test is not included. The matter was brought into notice by a recent case at Cardiff, where a motor cab driver was summoned on a charge of negligence, whereby he had collided with another vehicle. The magistrate, on finding that the man had been previously involved in a collision, ordered that his eyesight should be tested, when it was found that the left eye was useless and the right one was defective. The defendant undertook not to drive any vehicle again, and the magistrate warned him that if he failed to carry out the undertaking he would be fined the maximum amount of £50 for the next offence. When one remembers that railway engine-drivers and the drivers of tramway cars are subjected to severe eyesight tests before they are allowed to take their machine out on the iron road, it does seem remarkable that there should be no universal application of a sight test in the case of applicants for licences to drive road motor vehicles. There is comparatively little need for the severe test for colour blindness to which railway engine-drivers are subject, but in the case of a power-driven vehicle which is free to wander all over the surface of public streets, it is surely not too much to ask that for the safety of the public the driver should be possessed of ordinary distinct vision.

In common with other branches of the engineering trade, the heavy motor industry is suffering from increasing difficulties in the way of obtaining adequate supplies of skilled labour. The Society of Motor Manufacturers and Traders has given the whole matter consideration, and has communicated with the War Office urging that skilled men who have enlisted should be freed for the manufacturing work for which they are so urgently needed. If, as we think, this amounts to a suggestion that skilled mechanics who are also fully-trained soldiers should be transferred to civilian employment, we are of opinion that the Society is going too far. We should agree to the suggestion certainly so far as it concerns men who have enlisted for home service only, and possibly also as applicable to men who have enlisted recently, and whose military training is still in its earlier stages. By withdrawing a certain number of men of this type, the Government could probably fill the needs of its own arsenals and factories without encroaching further on the resources of engineering firms, many of which have Government contracts to fulfil. The attempt to safeguard the interests of contractors by refusing to take men direct from them into Government employment is not a practical success, and, moreover, the apparently high wages offered at Woolwich and elsewhere lead to some dissatisfaction among men in contractors' employment, since it is not fully realised that these high rates are necessitated by the unusually high cost of living in the vicinity of Government factories where the available accommodation is very severely taxed. It would be just as well if the Government's advertisements for men could be so worded as to make this point clear, and we assume that the Society has made a suggestion to that effect. Another obvious and successful measure would be to apply a fairly rigid system, under which men seeking Government employment would be required to prove by references that they had not been in the service of Government contractors since the outbreak of war. Without some such precaution, men will simply leave their positions and go into some private factory for a week or two in order to qualify for a Government job.

The increase in the wages bill and also in the cost of raw materials is making a very big hole in the profits which motor vehicle manufacturers anticipated out of Government contracts. There is a vague idea floating about to the effect that official opinion, if contract terms have to be altered at all, favours the payment of a sum estimated by ascertaining the exact costs of production from the firm's books, and adding a modest percentage for profit. Even this might be better than no profit at all, though it is doubtful whether it would be any more acceptable. On the other hand, in a case of this kind Government officials should remember that they are not merely purchasing lorries and putting money into the pockets of manufacturers. They are at the same time prohibiting those manufacturers from going about their ordinary business. Quite a number of the vehicles supplied by them before the war have been requisitioned. Their former owners are anxious for replacements. If they cannot get them from the same firm, they will get them from someone else. Consequently, the contractor is steadily losing valuable goodwill built up during many years of hard work. In

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MOTOR TRAFFIC.

the oversea markets, the Americans have an admirable chance of getting hold of his best agents, since the trader is determined to supply his customers with something and cannot wait for ever. Altogether, the contractor's position is by no means enviable in this particular trade, and as a rule he is quite willing to admit that he would have been fortunate had he been one of those not selected. At the same time, he is doing his best for the country, and his work is of the highest importance, so it would be most regrettable if his interests are permanently injured as a consequence. In one respect, one cannot help feeling that certain manufacturing firms will have themselves to blame for some permanent loss of goodwill. Goodwill must, under any conditions, be maintained, and if firms adopt the attitude that because for the moment they are unable to supply the ordinary markets, they may just as well allow the general public to forget their names and their existences, they are sure sooner or later to feel the consequences of a very mistaken policy.

Prior to the war there was much discussion as to the wisdom or otherwise of the War Department's regulations prohibiting the chain drive on subsidised lorries. When the crisis arose, large numbers of lorries were requisitioned regardless of the type of transmission embodied, and since that time manufacturers specialising on the chain drive, as well as on the live axle drive, have been carrying out extensive contracts. Naturally, the champions of each method continued to claim superiority for their own system under military conditions. From private advices, however, we are unable to conclude that the admitted superiority of some makes over others on active service bears any definite relation to the transmission system. There appear to be black sheep in each fold, while of certain representatives both of the chain drive and of the live-axle drive—whether by bevel or by worm—we hear uniformly good reports. In some cases trouble has been caused by over-gearing. In others, by insufficient strength of springs and their attendant fittings. In others again, by some weakness in the back axle. It certainly appears, however, that among the best performers are certain well-known subsidy models, which suffices to show that the live back axle, if properly designed, will surely stand up to the work. One point in connection with which we undoubtedly seem to be behind our opponents is the inadequacy of the protection given to the drivers. The body-work of the lorries is, we hear, satisfactory so far as it goes, but it does not go far enough, and in many instances rough constructive work has had to be done by the convoy drivers and mechanics to render the protection afforded more adequate, and to make the vehicles suitable for use for the carriage of spare parts and other essential articles of equipment.

PROPOSED CHARGE FOR ROAD UP-KEEP IN ULVERSTON AND DISTRICT.—The British Electric Traction Company have been asked to contribute to the cost of the up-keep of those roads over which their vehicles run and which are under the control of the Ulverston Rural and Urban Councils and Dalton Urban Council. At a recent conference of these councils it was decided to demand the payment of the sum of 2d. per omnibus-mile for road up-keep. The company very strongly objected to this charge and claimed that the bad condition of the roads was not due solely to their traffic but to the general traffic of the district, and contended that the roads should now be constructed in a manner suitable to the traffic.

A PETROL WAR.

The "eye-witness" who is present with the British general headquarters in the war, and who periodically furnishes records both of the fighting and of interesting collateral affairs, gave in the end of February an interesting account of the great part which petrol motor vehicles are playing in the present struggle. The communication, which was issued by the British Press Bureau on February 27, is as follows:

This war has at different times been characterised as a war of high-explosives, a war of howitzers, a petrol war. As generalisations of a picturesque kind these descriptions are all true; but the last is probably the most accurate, both in depicting an actual state of affairs and pointing out the direction in which there has recently occurred the greatest change in the material side of the conduct of operations. The mechanically-propelled vehicles now in the service include motor lorries or wagons of capacity varying from a few hundredweights to several tons, light box cars for the conveyance of rapid transit goods, motor ambulance cars, motor omnibuses for the quick transfer of troops from point to point, touring motor cars for the conveyance of officers, motor bicycles and side cars for scouts and dispatch riders, travelling kitchens, and steam tractors. The activities of the latter are mostly confined to the haulage of artillery and station work at the various bases, but the petrol-driven vehicles are to be seen everywhere. The number of the latter now serving the British Army in France amounts to thousands. The provision, manning, maintenance, and running of this vast fleet of motors, with one or two small exceptions, as well as that of all the steam and animal transport, falls to the lot of the Transport Department, and the magnitude of the work entailed may be imagined.

To start with, the vehicles are despatched from England as part of the original equipment of the transport of fighting units, or as "spares" for the replacement of casualties. The former proceed by road to the place of concentration of the formation to which they are allotted, and then start their life of utility in the service of that unit; and the latter go as far as the mechanical transport, or "M. T." parks, where they remain until required at the front.

The maintenance of the transport consists of: The replacement of damaged vehicles by entirely new ones; the supply of spare parts to enable minor repairs to be carried out in the field; the extensive overhaul which can only be done in workshops, such as those at the bases, equipped to carry out heavy repairs. In the replacement of entire vehicles there is little difficulty, provided that there is a sufficient reserve of them in the parks. The provision of spare parts, on the other hand, is a most complicated task, owing to the number of different types of vehicles in use.

Briefly, the system of carrying out repairs is in practice as follows: There are two kinds of M.T depots—advanced and base. The former are in the nature of retail shops, which keep a small stock of the spare parts most in demand and issue them direct to units when required, demanding them when necessary from the base depots, which, in turn, obtain them from England when they are not in stock. These parts are then sent up by the advanced depot to the unit concerned, and the necessary repairs are made by the artificers of the mobile workshops which form part of every transport unit. In addition to the mobile workshops to execute general repairs of a minor nature, there are tire presses at different points close up to the front, both stationary and mobile, the latter being installed on special railway trucks. By means of these presses the rubber on the heavy solid-tired wheels of motor lorries can be renewed without the vehicles having to be sent down to a base. The more extensive repairs or overhauls are carried out at certain very large and completely-equipped shops near the bases, where at present several hundred vehicles can be handled at one time.

Nothing can convey an idea of the magnitude and complexity of the maintenance and repair work of the transport better than a visit to a base. Here, in the M.T. parks, will be seen rows of brand-new vehicles either ready to take the road or in process of being tuned up to do so. At the depot, in the stores, will be seen stacks of tires several feet high, with narrow alleys running between them, and rows of "zerebas" of packing cases, each zereba being confined to the spare parts and accessories of one particular make of car or lorry. Within these partitions are hundreds of yards of pigeon-holes, often improvised out of empty packing-cases, in which the various articles are stacked and labelled, ready for issue. At another point are the workshops, where leather-aproned men in khaki are busy at forges, lathes, drilling machines, employed in the different kinds of metal work.

All this activity that goes on at the bases and advanced bases may not be fighting; but it is very much modern war, and to it is due the efficiency of the transport service upon which the Army depends.

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MOTOR TRAFFIC.

A FIELD MOTOR WORKSHOP.

The field workshop fitted on a 1-ton B.C. type live-axle chassis, manufactured by Commercial Cars, Limited, Luton, has been designed by the Royal Automobile Club Engineering Department, of which Mr. F. W. Hudlass is the chief engineer. The arrangements of the body, the hoisting gantry, and the general equipment of tools and parts are excellently thought out, and the Royal Automobile Club may be complimented on the finish of this useful machine. The aim of the designers has been to provide a compact little lorry that is not only capable of salving a car which has had a bad smash, but also of making any small repairs found to be necessary.

On the rear of the vehicle sheer legs are provided which project about 4 ft. Upon these can be suspended the front or rear of a car which, in this position, can be towed on the two remaining wheels. The sheer legs are also useful for lifting engines and gear boxes out of the frame. They stand on a large rear platform step which can be used as a bench for heavy work, and upon which is fixed a heavy vice. The interior of the vehicle is fitted up with a bench, racks and cupboards for tools, etc., also a 5½-in. centre lathe and emery grinder, the former being driven from the clutch shaft by a simple arrangement of counter shafts.

Field Workshop Built by Commercial Cars, Limited.

The tools equipment consists of such tools as would be necessary for carrying out work of the following nature:

Blacksmiths' Tools.—Sufficient for small forgings, and the straightening or bending of any parts.

Tinman's and Coppersmith's Tools.—For the purpose of soldering and brazing on any reasonably sized part, heat being derived from a large blow-lamp fed by petrol.

Fitters' Tools.—Such as are used for dismantling, repairing, and re-erecting any part of the motor vehicle, and which includes material and equipment for white metalling bearings, with scrapers, etc., for refitting same. There is also a small surface plate and a comprehensive selection of measuring and reference tools.

Turners' Tools.—Including drills, reamers, expanding mandrills, etc., in sufficient quantity to execute extensive repairs.

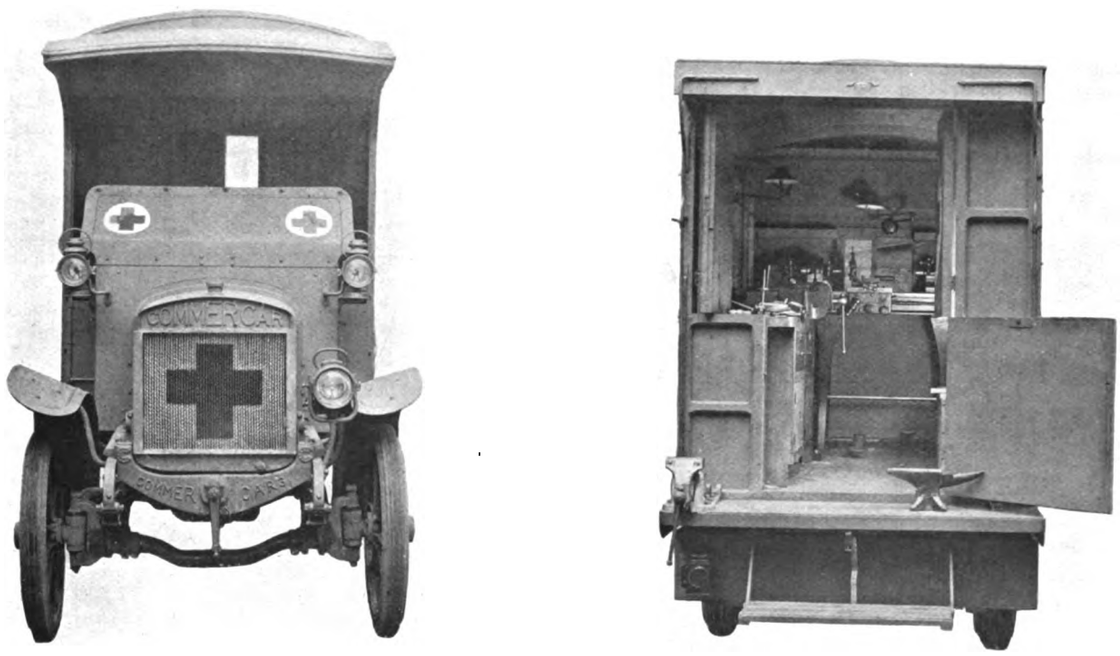
The material supplied includes tool steel, nickel steel, mild steel, and special steel for keys in a variety of sizes, also bronze and brass rods of various sections; sheet metal, wire, brake-lining materials, packing and jointing materials, and a large selection of useful sizes of bolts, nuts, washers, split pins, taper pins, etc.

Each repair van is sent out in charge of a competent man with a suitable helper; and, if possible, the helper is chosen for his knowledge of some particular craft that the charge hand is not thoroughly acquainted with.

Great care has been given to the selection of the spanners, of which a large variety are included in the equipment, so as to provide, if possible, any particular type from the largest to the smallest which may be required to negotiate nuts in an inaccessible position.

A glance at the list of tools provided would be sufficient to prove to the practical man that these vehicles are in every way as complete, if not more so, except as regards space, as the average country garage, of which every motorist is cognisant.

The vehicle is lighted by acetylene gas, and several small acetylene hand lamps provide light for work at night. The head lamps provided are also of the self-contained type, so they can also be used as a hand lamp when required.



Front and Rear Views of Field Workshop Built by Commercial Cars, Limited.

MOTOR OMNIBUSES FOR BURTON.—At a recent meeting of Burton-on-Trent Town Council, a petition was received from residents in the western end of the borough and the rural area beyond, asking that a motor-omnibus service should be instituted to connect those areas with the tramway system. The Council decided to apply for a Provisional Order to cover all portions of the borough which the tramway system does not serve.

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RUNNING COSTS OF MOTOR VEHICLES.*

By Lieut. Robert W. A. Brewer, A.M.Inst.C.E., M.I.Mech.E., M.S.A.E.

The automobile engineer has as a primary duty, to effect the transportation of goods or persons from place to place in the minimum of time and at a minumum cost. As regards economy of time, the development of the high speed motor car has shown that it is capable of competing with any known method of transit except the aeroplane. The second consideration, that of cost, is perhaps of even more importance, as transport on a large scale is a great commercial factor at the present time. This matter has received the attention of traffic experts during the past few years, and it would, therefore, appear presumptive to dilate upon the subject from the commercial point of view, but it will be profitable to discuss the main features which control the working costs, both of the pleasure car and the commercial motor.

Although the automobile has been developed to such a state of reliability that it plays a most vital part in the affairs of the world, there are wide practical divergencies, even now, between various types and various machines when their individual performance is closely examined. These differences of design and performance are manifest principally under certain heads, which may be set out as follows:

(1) Fuel cost and consumption.
(2) Lubrication systems and consumption of oil.
(3) Wear and maintenance.
(4) Tires.

The question of depreciation may be left out, as that generally can be considered under the third heading. All of these items can be directly measured, some of them from week to week, from the cost sheets, and others at longer intervals, when extensive renewals must be made. The object of this paper is to put on record certain known means by which some of these costs can be reduced, first investigating their causes and seeing how they can be influenced by the skill of the engineer.

The Sources of Cost.

The fuel cost is governed by a large number of circumstances apart from the particular locality in which the vehicle is operating. Naturally local conditions affect working costs to a great extent. The contour of the country, frequency of stops, and the average speed of the vehicle are matters generally outside the control of the engineer, and we will therefore pass over them. They do, however, affect the general scheme in determining the power which must be developed by the engine in order to surmount natural obstacles and to produce such an acceleration of the vehicle as will enable a good average speed to be maintained.

For many purposes, however, in the case of pleasure vehicles, we cannot put it down as an axiom that the engine which is *capable* of producing the greatest power, is proportionately a greater fuel consumer per mile of road travelled than a less powerful engine of similar general form. There are so many other considerations which come into play that it is impossible to generalise on the relation between engine size and load factor on the one hand and fuel consumption on the other. Everybody is quite familiar with the fact that fuel consumption expressed in miles per gallon does not, within wide limits, vary between, say, a car weighing 1·5 tons unloaded with an engine of 100 mm. bore and a car weighing 1 ton unloaded with an 80 mm. bore engine. There is a generally accepted figure of, say, 25 miles per gallon under ordinary working conditions, with petrol as fuel, which should be attained by all such vehicles. The fact is that, within limits, the power required from the engine to propel such a vehicle in an ordinary day's run would average 9 to 10 H.P. to be given at the road wheels.

Now a rather curious fact comes to notice. It might be expected that under given road conditions the small engine would be working at a higher volumetric efficiency, and would give manifestly greater economy than the larger engine working under presumably lower volumetric efficiency. In actual practice, however, this is not borne out, the reason being as follows: The small engine operates with a reasonable amount of throttle opening, but in spite of this fact, its smallness of size precludes it obtaining a high rotational speed when top gear is in operation until such a time as its rate of increase of power is notably greater than the rate of increase of car resistance. If these two factors are fairly equally matched acceleration is small, and an appreciable time elapses before a high car speed is reached. In this country, however, one cannot retain the throttle wide open for lengthy periods on account of road conditions. The volumetric efficiency of the motor will, therefore, not be unduly low. Were it possible to hold the throttle wide open, in course of time the car would attain speed and the power production of the motor increase proportionally or nearly so.

The big-bore engine, however, is held in check during the greater part of its working period by reason of the small throttle opening permissible, and with modern carburetting appliances it does not appear that its economy in working is much affected thereby. This may, in a measure, be really due to the fact that any losses incurred on the level are compensated for on gradients, when the motor can be kept running at a comparatively slow speed, the top gear being used, whilst its smaller brother is revolving quickly and operating through a lower gear ratio. From theoretical reasoning the large engine working throttled down, *i.e.*, with reduced compression,* should show a high fuel consumption, and on the test bench, of course, this is so, and we may take a round figure of 25 per cent. increase in consumption per brake horse-power per hour developed as representing the difference of fuel efficiency under the two conditions named. Were it possible to continue for any lengthy period upon the road under the said conditions, no doubt an appreciable difference in fuel consumption would be shown. On the other hand, let us consider for a moment how a great many fuel consumption road tests are made, as regards throttle opening. With the exception of those tests made by works testers upon a strange carburettor, the results which find their way into the press are almost always obtained under a low load factor.

This may be due to several reasons such as a desire to keep the wind resistance down, so that the actual power required to be developed by the engine is comparatively small. Under such conditions the time element is considerable and the period occupied in covering a mile greater. This is counteracted, however, by the fact that at a low speed the power developed by the engine is lower, and mileage per gallon tests usually take no count of the power developed, in other words, the fuel per brake horse-power-hour—and seldom of the fuel per ton-mile.

The power is, however, an all important factor in making comparisons, and the careful use of the accelerometer *in all such tests* is the only method of obtaining data of any real value. The power developed by the engine as a mean value can only be gauged accurately by a recording instrument, but for comparative work two different cars will afford the observer useful data. Several tests made by the author in this manner have proved very instructive in showing that, with careful driving, ordinary pleasure cars, in good condition, give very similar fuel consumption results though they may differ widely in general form and weight. The author here ventures to express an opinion that the fuel consumption of an ordinary car reckoned in this manner is far from what should be obtained.

To proceed further with the investigation, let us follow the uel from the tank. Much has been said and written on the first process through which a liquid fuel must pass before it becomes a suitable agent to perform work in the cylinders of an internal combustion engine.

In no engine is fuel burnt in its liquid state, the motor with which we are most familiar being a gas engine requiring as its motive power a gas, homogeneous throughout its mass and uniform in quality from one period to another. This latter observation is open to modification, however, from theoretical reasons, as it is a fact that a high compression can deal with a weak mixture economically. We know for a fact that when a large-bore motor runs for considerable periods, say along a level road, at a low load factor, economy results from weakening the mixture and increasing the throttle opening.

Dr. Watson has graphically represented to the Institution of Automobile Engineers the fact that mixture strength can undergo a considerable variation without appreciably affecting the power produced at full throttle opening. By a careful manipulation, therefore, the critical point of the mixture strength and power curve can be avoided whilst economy of working of no mean order will result, when the maximum thermal efficiency can be reached, and the power remain unaffected. This fact will be considered later, but is mentioned to indicate the reason why the fuel efficiency of a large engine can become comparable with that of a smaller one under the conditions under consideration.

The Efficiency of the Engine.

An internal-combustion engine is termed efficient or otherwise, in a somewhat loose manner by the general public. By an engineer, however, the term "efficiency" may be applied in one of several meanings, *e.g.*:

(1) Mechanical. | (3) Volumetric (swept by piston).
(2) Thermal. | (4) Specific volumetric (H.P. per litre).

The mechanical efficiency is the most commonly considered in engineering practice, being a survival of steam engine methods. In

* Paper read before the Society of Engineers, March 1, 1915.

* The compression *ratio* is not reduced.

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automobile work it is the least often referred to by reason of the fact that brake tests are the means usually employed for measuring the power output of an engine rather than indicated horse-power. Probably this is one reason why the mechanical efficiency of the modern internal-combustion engine is left to look after itself, rather than to become a scientific study. As a concrete example, those who can quote a reasonably exact figure for the mechanical efficiency of a modern valve engine and a Knight engine are probably a small minority, yet working costs are much affected by this value as attained in practice.

Again, there is an absence of data with regard to such items as piston friction, either as a direct measurement or as a comparison between various types, such as cast iron and steel, or parallel and waisted. The relative merits, too, of forced and splash lubrication for crank shafts are still a debatable point, although it is generally agreed that for heavily and continuously loaded shaft bearings, directly forced-oil feed is the only system which will stand up.

The proper application of lubricant to bearing surfaces is a subject which has been well considered by mechanical engineers since the earliest days of the science, but many of the theories of ordinary mechanical practice have been entirely broken down by the advent of the automobile. The lubrication question is one requiring much careful thought and experiment by members of our profession by reason of the fact that faulty lubrication is at the root of the majority of failures under really heavy loading. It is only necessary to recall failures in some of the more prominent races to acknowledge the truth of this statement, yet advance in methods of lubrication has been very slow.

Racing conditions are complied with by trial and error, a laborious and expensive method, and in some quarters a departure from known and common practice will not be considered by reason of a lack of appreciation or understanding of the underlying principles. Yet there are, undoubtedly, certain principles which apply in the lubrication of a high-speed crank shaft, which are peculiar to that part, and which must be considered accordingly.

In one case in which the author was engaged a very obvious fault in the lubrication of this detail was evident and was remedied by suitable treatment, the exact details of which were not disclosed until later. The results aimed at were attained satisfactorily, and there was no evidence of metallic contact having taken place between the lubricated surfaces after much hard running. When, however, the details of the alterations were made known to the makers, they were condemned as being unsuitable. The only reason for such an action could be that a departure was made from their own customary practice, combined with an ignorance of what was actually taking place under the new conditions. Such instances can be multiplied in other directions, and a fuller knowledge must be gained before a great step can be taken in the reduction of engine friction.

Piston friction has already been referred to, and even now there are no general data as to the effect of various modifications which have been made to reduce this. Apart altogether from the material and form of the piston, there is a great divergence of opinion upon the ring question. Not only is the number of rings still an unsettled matter, but their disposition and shape also call for attention.

The author's opinion tends to the belief that for touring car work a piston touching the cylinder throughout the greater part of its length, fitted with two rings at the upper end, should meet the case. By "touching the cylinder" a parallel clearance is inferred as distinct from a waisted piston.

In such a design, the various machining clearances are of great importance, particularly in view of the distortion, both of the cylinder and the piston shortly after they have been put to work. The author has found this distortion to be very great in several different makes of engines, and the manufacturers themselves have scarcely credited the movement of metal which has been pointed out. Such practical considerations have an important effect upon the results obtained on test and show the necessity, when the best results are desired, for some heat treatment or rest between the operation of the first rough boring cut and the final grinding. The reason for this is two-fold, the expansion of metal and partial distortion at high temperature, and the presence of the oil film.

The author has run satisfactorily pistons of 70 mm. diameter with a skirt clearance of six-thousandths of an inch cold, without any sign of knock, and has obtained most satisfactory results as regards reduction of piston friction with this clearance. Insufficient piston clearance is responsible for a great deal of the loss of efficiency at high speeds which exists in many motor car engines, and this is undoubtedly as great a source of loss as insufficient valve diameter.

Clearance of metal between the rings is a matter of some difficulty to define and depends upon piston thickness and design, but there is no necessity for any attempt at closeness of fit here. Importance must, however, be attached to expansion allowance for the rings, and this should be from six-thousandths to fifteen-thousandths of an inch according to the perimeter of the ring.

Piston friction being so important an item in the total of engine friction, the question of piston *fit* is one requiring attention both by reason of the thinness of the metal and the available space for the lubricant. The former factor depends upon the degree of weight cutting which is to be attained, and the latter is governed by the rate of linear piston speed to be maintained for continuous periods of working. Apart from manufacturing tolerances a convenient rule is adopted in some quarters of one-thousandth of an inch of clearance in the diameter across the piston skirt per inch of piston diameter.

A proposal has been made in America to allow two-thousandths to 2½-thousandths per inch diameter of piston above 2 in., with a maximum allowance of four-thousandths for a 2-in. piston and a 4·8-thousandths for a 3-in piston. At this latter rating a piston of 3½ in. diameter would have a clearance of five-thousandths of an inch, which would be quite permissible in a high-speed motor. It must not be forgotten that clearances in the state of cold metal do not represent working conditions, and although it may be supposed that piston knock might occur by reason of this apparent looseness of fit in the cold state, no actual knock would exist under working conditions.

With further regard to the piston itself much can be said, but when lightness of construction is desired the waisted piston has many features worthy of recognition. Apart from racing practice, and looking at the piston as a mechanical appliance whose function is to transmit the energy produced by the expansion of a gas into a linear movement, the piston has two main features; first it must be sufficiently strong to resist all tendency for its head to collapse, and secondly, it must act as a thrust slipper, having a minimum of friction upon the cylinder walls.

The first consideration does not have much bearing upon the subject of this paper, but undoubtedly the second is of some importance. It is the author's opinion that much unnecessary friction is entailed by reason of pistons fitting too closely at points where there is really no object in maintaining any contact at all. Therefore the waisted piston facilitates construction and tool work by requiring only a comparatively small area to be machined to a degree of great accuracy. Further the question of distortion is more easily dealt with by reason of the smaller contact areas. Time will not permit of a further digression upon this most important subject, but any definite data upon the question of the relative friction of pistons of different materials would be welcome.

Valve Mechanism.

With the exception of the most elementary forms of two-stroke cycle motors, all the modern internal-combustion engines demand expenditure of work for the purpose of valve operation. It is difficult to state exactly how much of the total power developed is absorbed in this function: probably only a small proportion, but it all counts. The only portion worth considering is that necessary to start the exhaust valves from their seats, a momentary effort. The actual mechanical efficiencies of valve and sleeve motors are no doubt approximately the same, in so far as valve operation is concerned, and in view of Dr. Riedler's experiments we may take it that there is little room for improvement in this respect.

Transmission Losses.

Whilst considering frictional losses we will briefly pass from the engine to the transmission gear, and it is here in the majority of cases that the greatest scope lies for elimination of frictional loss. Modern methods of chassis construction tend towards the two-unit system, where cheapness of erection is concerned. Undoubtedly this is good practice, by reason of the fact that lining-up need not to be so carefully carried out.

The introduction of leather and fibre disc couplings has somewhat modified the problem, however, as such couplings are quiet in running, require no lubrication, and have a very low frictional loss. The interposition of such a coupling at each end of the gear box reduces frictional tendencies due to displacement of any transmission unit, though a two-unit scheme attains the same end in a more mechanical way. Whether the double unit should be at the engine or axle end, or in the latter case whether it should be at the front or rear end of the propeller shaft, has scarcely yet been definitely decided. Good arguments can be raised in favour of both methods, though we find that one great exponent of the two-speed axle in 1914 has discarded this practice in the current year's model. It is the author's opinion that rear axle weight is much too great, and that frictional losses could be reduced in a lighter design. Not only this, but a great unsprung weight imposes other losses of power when running on rough roads, so great that they are well worthy of careful attention. The right-angled drive is a subject upon which valuable data is already available. We will, therefore, omit this detail from discussion at the present time.

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MOTOR TRAFFIC.

Gas Friction.

So far we have dealt only with the frictional loss of lubricated surfaces, but there is another most important feature which controls engine efficiency and consequently working costs. It may not be apparent at first sight how gas friction plays an important part, as the actual friction of a gas passing through a pipe or port is comparatively small. Where the loss occurs is not the actual friction of the gas, in so far as absorption of power in driving the gas along the passage is concerned, but in the reduction of the volumetric efficiency of the particular engine.

Supposing we have for example an engine of certain linear dimensions producing a definite horse-power at the brake at 1,000 revolutions per minute. The frictional loss due to lubricated surfaces is then a certain measureable quantity. At double the rate of revolution the frictional loss will be, say, twice as great, and in order to maintain the mechanical efficiency of the motor the power output should increase at the same rate as the frictional loss increases. If, however, the power output is restrained by a reduction of volumetric efficiency, the mechanical efficiency of the motor drops.

Now volumetric efficiency is a function of gas friction, and if the latter is abnormally high we can quite conceive an engine with a very small brake horse-power output at high speeds. It is only necessary to refer to tables and curves which have appeared in the proceedings of the Institution of Automobile Engineers from time to time, to realise the importance of reducing the friction of the gases between the carburettor inlet and the cylinder head. It must be remembered that atmospheric pressure alone is available for forcing the working fluid into the cylinder upon the charging stroke, and that the difference of absolute pressure at the two points above referred to must be kept as low as possible if a good volumetric efficiency is to be attained.

There are, it is true, methods of jockeying in order to compensate for inherent defects in a badly-designed motor, but these are mere tricks to overcome an immediate difficulty. One, for example, which has been adopted by the author in a certain case, was to design a special form of induction pipe to take advantage of the inertia of the pulsating gas, and to alter the valve setting in such a manner that the pressure waves in the induction pipe assisted in the cylinder charging process. In a badly-designed induction pipe, these pressure waves are expended in the direction of the carburettor, causing blowbacks. Engine power has, therefore, to be expended in reversing the gas flow in the pipe from the carburettor to the manifold, and, in addition, difficulties of efficient carburation become manifest.

A ruling factor in the matter of gas friction is that of efficient carburation, and a certain restriction must be embodied in the design in the vicinity of the carburettor jet, in order to disintegrate the particles of liquid fuel effectually. Too large a choke tube entails fuel loss by reason of the lack of homogeneity in the mixture passing through the induction pipe, the fuel being carried forward in large drops. From the choke tube, the pipe should expand in a gradual taper in true stream line formation, as no advantage can be gained by using an abnormally large pipe with a small carburettor attached to it. Conversely, a large carburettor, as already shown, becomes inefficient with a low gas speed.

It may be stated in some quarters that a low gas speed can be used satisfactorily with certain types of instruments, but it is the author's opinion that a gas speed of much below 200 ft. per second is insufficient to secure that mechanical effect upon the fuel which is necessary with modern petrol. Such a gas speed corresponds to a water head of about 10 in., or rather more than one-third of a lb. per sq. in. Much higher speeds are found in modern practice, a figure of three times this amount being not uncommon, but the resulting loss with such high velocities can be readily approximated.

Having determined the maximum speed of the gas through the choke tube, it only remains to reduce that speed gradually throughout the intervening passages, but only gradually. Any sudden fall in velocity will be accompanied by carburation difficulties, due to the precipitation of the liquid, which will inevitably occur unless special means are provided to counteract it. Although a favourite modern practice provides an induction port passing through the water jacket, both to produce compact design and to provide the necessary heating, the author is of opinion that a better method exists in the system he has devised for improving carburation.

Gas friction, like that of a liquid, depends upon the velocity of the fluid, the size of the pipe, and also its continuity of direction. If, therefore, efficiency of flow is to be obtained, any changes of direction must be accomplished as easily as possible. When a volatile liquid is employed, the liquid will remain in a gaseous form even though it undergoes certain interference through variation of velocity or turbulence.

Petrol of the modern composition is, however, another matter, and owing to its complex nature, is very prone to return to its liquid state upon the least provocation. Petrol in an induction pipe is not all vaporised but only atomised, in other words, held in suspension in a liquid form. Irregularities in the direction of flow cause precipitation, which is most disastrous to the homogeneity of the mixture, and this can only be provided against by vaporisation.

The boiling point of the heavier fractions of motor spirit is considerably higher than that of water, anything up to 150 deg. C., so that the temperature of the water jacket cannot be sufficiently high to cause vaporisation of the heaviest fractions in many modern motor fuels. It is to the heavier fractions, therefore, that one must look for trouble. The point at which this occurs is at the point of change of direction in the flow path, and at such points a sufficiently high wall temperature must be provided.

Local heating of the induction manifold does not entail heating up the whole of the mixture, and thus reducing the weight of gas per charge taken into the cylinder. It is not the *quantity of heat* provided which counts, but the application of a sufficiently high temperature at the correct points. If this is carried out in a scientific manner, the temperature of the gas entering the cylinder will be approximately that of the outside air, sufficient heat only being provided to equal the latent heat of evaporation of the fuel. A finely-divided vapour is produced in a device of this nature, in appearance similar to tobacco smoke, and one need scarcely point out that efficiency of combustion results.

In spite of the fact that an internal-combustion engine reaches in actual working a higher thermal efficiency than any other type, yet the cost of its fuel compared with that of, say, coal is so high that worked on a fuel cost basis the petrol engine shows rather bad results. The question of fuel cost *per se* is outside the scope of this paper, but in the matter of efficiency, cost is the basis which the whole matter is reduced to in the long run. The cost of petrol, all are agreed, is an artificial one, but unfortunately we can see no real practical alternative at the present moment. So it behoves the designer to use the best means in his power to reduce the fuel consumption to a minimum. It is the author's opinion that insufficient attention is paid to the important factor of light load consumption. Economy can be attained by using weak mixtures at high compression rather than by using a greater mixture strength at low compression, as is generally the case, as instance, the former in gas engine practice. Fuel waste largely arises from loss at light load or when running idle, and this is mainly due to faulty carburation.

In order to overcome the tendency to starve the engine due to lack of volatility of fuel at low suction or low gas velocity, in the majority of instances an excess of fuel is passed into the induction pipe, only a portion of which is burnt efficiently, the remainder passing through the engine either in the liquid state or partially converted into CO and CO_2 during the process of combustion. There is no great difficulty in obtaining good fuel consumption figures at maximum power output with the majority of carburettors, but how seldom does such a state of affairs exist in actual practice throughout the range?

The most satisfactory and only reliable method of making fuel consumption tests is in conjunction with the accelerometer, and the author has shown in some of his published tests how the power required to drive a car may vary enormously from moment to moment on the same road or track, and how this power varies from day to day. This is due largely to wind resistance and rolling resistance. The former is a matter which is at the power of the designer to lessen in a certain measure. Suitable body contour should be insisted upon by the designer of the chassis, in other words the complete car and not only the chassis should be designed in the works, whenever economy of working is a feature to be aimed at. Elimination of wind resistance has become better appreciated in recent times, a stimulus having been given by the method adopted for the Treasury rating of horse-power.

Whatever be the faults of the present formula, it has been the means of attracting the attention of designers, not only to the "efficiency of volume" of the motor, but what is equally important, the better design of body work from the point of view of resistance imposed. We may take it for a fact that in still air, the wind resistance of a motor car body, at speeds up to 20 miles per hour, is negligible. The total resistance is represented by the rolling resistance, which on good roads is of the order of 70 lb. per ton. Weight here is the ruling factor.

The figure of 70 lb. per ton will give the mass an acceleration of 1 ft. per second per second, so that in making a test with the accelerometer, the reading would show 1 ft. per second per second when the clutch is withdrawn.

Road resistance, however, varies enormously, and as a case in point the author's car proceeding along the road between Hounslow and

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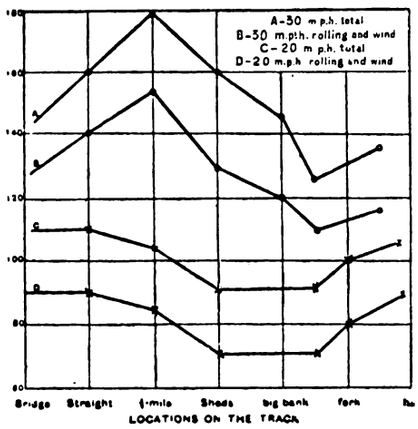
Staines recently was observed. Part of this road has been relaid with an asphalte facing, the remainder being rough macadam. The throttle was set so that the car speed on the asphalte was 30 miles per hour, but on reaching the macadam, the speed dropped in a few seconds to 23 miles per hour, where it remained.

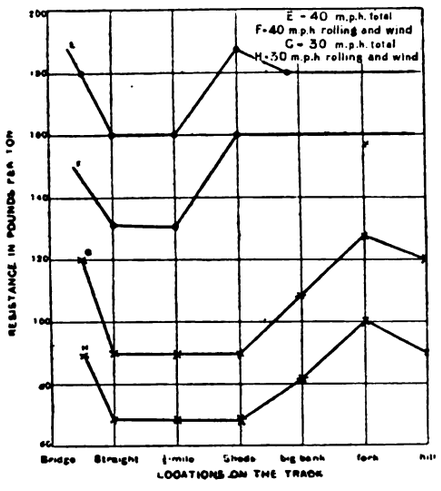
Brooklands tests made by the author over periods extending to a week at a time, have shown how that, even on the track, the total resistance not only varies from point to point on the track, but also from



Curve C shows the total resistance of the test car in pounds per ton at 20 miles per hour. Curve D shows rolling and wind resistance. The difference is due to frictional loss. Curves A and B show the resistances at 30 miles per hour.

Fig. 1.—Typical Resistance Values at Brooklands.

day to day. In one complete circuit, the resistance is often 50 per cent. greater at one point than at another, and it has been measured as high as 190 lb. per ton at high speeds on a touring car. Full details of tests have been given in *The Automobile Engineer* and in the American *Automobile*. During these tests the author has been able to observe the resistance caused by the number plates and that due to eddy currents in the folded hood.



Curve G shows the total resistance of the test car in pounds per ton at 30 miles per hour. Curve H shows the rolling and wind resistance at the same speed. Curves E and F show the resistances of 40 miles per hour.

Fig. 2.—Typical Resistance Values at Brooklands.

As a result of tests it has been found that suitable curvature of the body lines reduces the total wind resistance by 50 per cent. as compared with normal surface resistance. At speeds of 30 miles per hour a car of average form experiences a wind resistance practically equal to the rolling resistance. At higher speeds the wind resistance preponderates very appreciably.

Total car resistance is influenced by the question of balance; and not only does this apply to the wheels, but also to engine parts and the propeller shaft. Very often one finds that propeller shafts do not run absolutely true, and loss of power results.

As a matter of experience, the author ventures to suggest that the single-jointed cardan shaft is liable to cause greater loss at high speeds than double-jointed shafts. We must not lose sight of the friction due to sliding joints in the transmission, but such loss is difficult to measure. The accelerometer will discriminate between engine frictional loss and transmission loss, but no further at present. Under the heading of transmission loss comes windage, and it may be possible to divide these losses further by making tests in opposite directions, in a known wind.

Expenditure of power due to uneven road surfaces can only be met by the designer in two ways, the reduction of unsprung weight and a

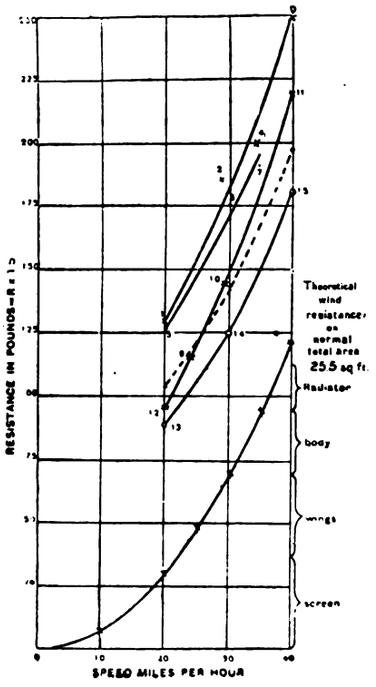


Fig. 3.—Curves of Resistance and Speed.

(The curves show resistance of the same car under different conditions during one week on Brooklands track.)

system of springing such that the main mass of the car does not become affected by the wheels bouncing. Much attention has been given in recent times to the spring suspension of an automobile, and there is no doubt that the Lanchester system is holding its own. This subject has been well considered, but there is still much to be learnt and appreciated. The subject has, hitherto, been considered rather from the point of view of the comfort of the occupants of the car than from an economical standpoint. A calculation could, however, be made, to show approximately the loss of energy entailed in jolting a heavy car body along the road. The fuel bill, when motoring in a rough country, such as is the author's lot at present, forcibly brings home the fact that much fuel and money are needlessly wasted in causing discomfort to the driver and wear and tear to the car as a whole.

York Electric Omnibuses.—The first of the Edison electric omnibuses which were recently ordered by York Corporation has been delivered.

New Steel Wheel for Industrial Motors.—A new type of steel wheel manufactured by the Creery Wheel Company, of Scotstoun, Glasgow, has just been placed upon the market, and is of considerable interest by reason of the fact that it affords a means of solving the question of eliminating unnecessary sizes. The wheel is built up of two parts, the wheel centre and spider being made in one size only, but they are able to accommodate any of the existing sizes of tires in use on industrial vehicles. As the rim is not cast with the spider the important question of faulty castings is largely eliminated. The centre casting carries the spokes, the ends of which are joined to the rim by bolts. The rim is a circular steel casting, to the outer face of which the tire is directly vulcanised in the ordinary manner, the inner edge carrying a flange which is bolted to the ends of the spokes. The simplicity of this arrangement will commend itself to all interested. Furthermore, the tire costs are reduced, inasmuch as no steel foundation ring is required. There is a further advantage in the saving of weight.

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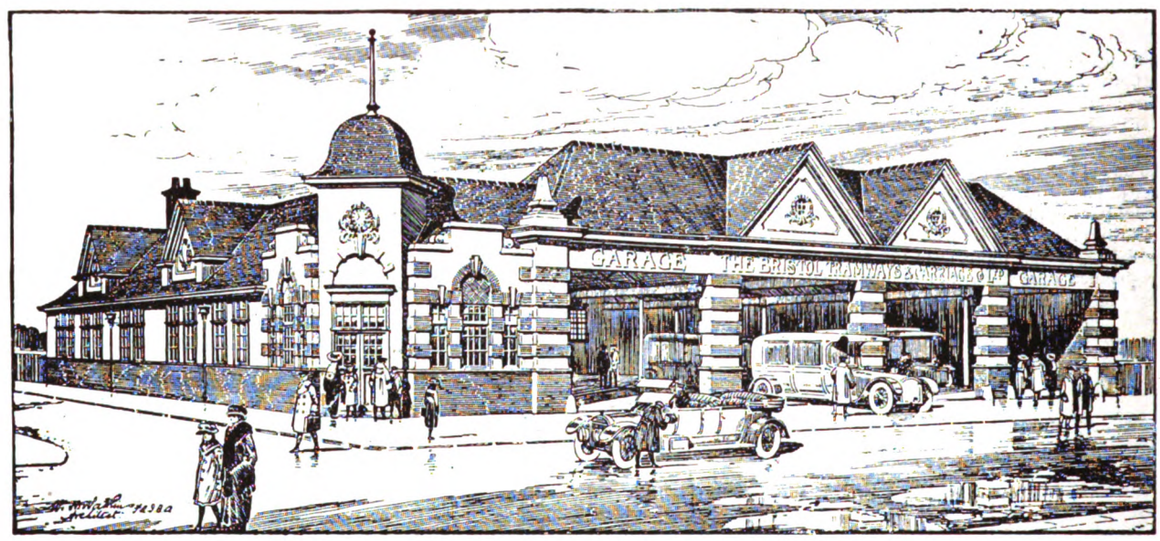
MOTOR TRAFFIC.

BRISTOL TRAMWAY COMPANY'S GARAGE AT AVONMOUTH.

The accompanying sketch shows the spacious and attractive new garage which the Bristol Tramways and Carriage Company is erecting at Avonmouth. It will be a fine addition to the buildings in the main thoroughfare, near the Miles Arms Hotel. The growth of the district and the increasing call for motor communication between Bristol and Avonmouth has rendered this enterprise of the company necessary. Some idea of the increase of the motor 'bus traffic may be gathered from the fact that from an original service of two omnibuses the company has found the patronage grow to such an extent that steadily the number of omnibuses has been increased to nine. These run regularly every day, including Sundays, between the Tramways Centre, Bristol, and Avonmouth, giving a 12-minute service, which has been found to be a great convenience to those having business at the river-mouth docks. On Saturdays and Sundays, and on special occasions, as many as 14 omnibuses have been requisitioned.

The necessity of a garage has thus arisen, and an artistically-designed building is in course of erection. It is the design of Mr. W. H. Watkins, F.R.I.B.A., of Clare Street, Bristol, to whom we are indebted for the accompanying sketch. The new garage will have a frontage to the main road of 120 ft., and will be about the same depth. It will accommodate between 20 and 30 motor 'buses, 12 taxi-cabs, and 20 commercial motors. In addition to this large provision for vehicles there are to be offices, a spacious waiting-room, messrooms for the staff, workshops, and stores. The elevation will be of Cattybrook brick facings and rough cast. The roof will be covered by Brosely tiles, and at the corner will be a handsome clock turret. There are to be four openings on to the main road for the conveyances, with iron roller shutters. It is hoped the building will be ready for use in a few weeks.



Bristol Tramway and Carriage Company's New Garage at Avonmouth.

NEW MOTOR OMNIBUS AT BRISTOL.

The new motor omnibus which was on view recently on the occasion of the annual meeting of the shareholders of the Bristol Tramways and Carriage Company is now complete, and will be put into service on the Tramways Centre and Suspension Bridge route immediately the Licensing Committee issue the usual hackney carriage licence. The omnibus has been built in its entirety at the company's Motor Constructional Works, Brislington, from the designs of the works staff. Much attention has been given to the matter of ventilation, and it is hoped that this has been secured without causing any rattling of windows. There are hinged ventilators in the lantern roof, and the three front windows are made to drop just far enough to ensure an ample supply of fresh air, at the same time avoiding a direct draught reaching the passengers. The side windows are made in such a way that they can be readily removed during the summer months.

The engine and chassis are of the company's latest improved type, and the engine develops a high horse-power. A special feature is the electric lighting of the omnibus both inside and outside, and for the head and tail lamps, the omnibus generating its own current by means of the revolving axle operating a dynamo associated with which is a powerful storage battery. The omnibus is constructed to seat 29 passengers, 27 inside and two on the driver's seat. The coach work throughout is of a high-class character, and combines with the artistic painting to give the car a conspicuously attractive appearance.

THE TROY TRAILER.

A new road vehicle which should add considerably to the efficiency of heavy road transport has just been introduced to the British market by the Troy Trailer Construction Company, Limited, of 49, Pall Mall, London. In normal times it has always been an open question as to the economic value of the trailer by reason of the fact that, quite apart from the time factor in loading and unloading, the restricted speed at which it has been possible to travel has had an important bearing upon the net cost of transport. The designers of the Troy trailer have evidently realised that in order to fully meet the position, special arrangements were necessary whereby the maximum load could be carried and the trailer towed with perfect safety at a speed equal to that usually run by rubber-tired commercial vehicles. As a result, an entirely new type of vehicle has been produced, which in every respect is a very great advance upon anything that has previously been used for this purpose.

The Troy trailer has a substantially constructed frame of rolled channel steel well sprung and so arranged that all wearing parts can easily be adjusted or renewed. The chief feature, however, in the design of this vehicle is the steering arrangement. Steering gear of the Ackerman type is provided at each end of the trailer, so that in whichever direction it may travel it will follow in the same track as the tractor. Moreover, when it is desired to travel backward the trailer can be accurately steered. All that is necessary is for the steering gear in the rear axle to be locked for forward motion and *vice versa*.

TENDERS INVITED AND ACCEPTED.

Metropolitan Asylums Board invite tenders for the supply of four single-deck motor omnibuses and six chassis for ambulances. Full particulars, together with form of tender, can be obtained on application to the clerk of the Board at their offices on the Embankment, London, E.C.

Ilford Urban District Council invite tenders for the supply of an electrically-driven coal wagon.

Westminster Corporation have accepted the tender of the Avon Rubber Company for the supply of solid rubber band tires.

MANCHESTER MOTOR SHOW ABANDONED.—The promoters of the proposed motor exhibition, which was to have been held in Manchester during the month of April, have decided to abandon their project, and to return in full all the deposits and moneys paid by prospective exhibitors.

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MOTOR TRAFFIC.

LONDON GENERAL OMNIBUS COMPANY.

ANNUAL MEETING AND ACCOUNTS.

Mr. C. J. Cater Scott presided at the meeting of this company, held at Electric Railway House, Westminster, on February 18. In moving the adoption of the report the chairman pointed out the impossibility of making any comparison with the results of any previous period, owing to the absorption of the New Central and Metropolitan Steam Omnibus Companies, and to the fact that the Government had taken over a large part of their undertaking for war purposes. The figures in the balance sheet did not make any provision for allowances which might be made hereafter by the Government for the use of their property. He thought that the omnibus company was giving very satisfactory though necessarily curtailed services under the present conditions. They were rendering to the Government services of a very diversified character, including the supply of omnibuses and motor lorries in large numbers, and the use of some of their garages and shops. At their splendid training school at Chelsea they were training drivers for motor transport abroad, and they had sent about 2,000 men as drivers of motors abroad, in addition to whom 2,500 employees had gone for war service, aggregating about 4,500 employees of the company, or approximately 25 per cent. of the staff. An important event during the early part of the year had been the granting of improved conditions of service and rates of pay to a large number of employees. These concessions had considerably increased the working costs, but the results justified the additional expenditure. At the present time he could safely say that the relations between the officers and employees were of the most cordial character. The board's constant endeavour had been to reduce the number of accidents, and it was some consolation to notice that the fatalities were 30 less than for the corresponding period in the previous year. He felt that this result would have been improved but for the restriction of street lighting since the commencement of the war, which greatly added to the danger, not only of omnibuses, but to all street traffic.

The accounts, which were approved at the meeting of the company, are not nearly so detailed and explicit as those which have to be published by railway companies, nor so full as those issued by municipal tramway undertakings.

	1914.	1913.
Capital authorised:	£	£
Shares	1,650,000	1,250,000
Debenture stock	3,250,000	3,250,000
Total	4,900,000	4,500,000
Capital issued:		
Shares	1,600,480	1,150,480
Debenture stock	1,978,782	2,000,000
Total	3,579,262	3,150,480
Capital expended during the year	327,530	424,887
Revenue:		
General receipts from traffic, private hire, advertising, and sundries .. .	3,226,540	3,258, 98
Expenditure	2,605,228	2,709,826
Net revenue	561,312	488,372
Deduct for deprecation and reserve ..	192,417	191,614
Credit balance	368,895	296,758
Amount available including balance forward and interest	435,624	346,730
Deduct debenture interest, sinking fund, and amount written off preliminary and liquidation expenses	115,000	105,446
Balance	320,624	241,284
Dividend on shares at 16 per cent. per annum	256,077	207,086*
Balance forward	64,547	34,198
Working expenses details:		
Traffic	1,501,700	1,542,703
Maintenance	1,009,782	1,102,218
General	153,746	124,905
Total	2,605,228	2,769,826
Percentage of expenses to receipts	82·6	85·01

* At 18 per cent. per annum.

It is, among other things, to be regretted that there is no statement of total capital expenditure to date, nor of the number of miles run and passengers carried. The grouping of the working expenses is under comparatively few heads, and a great many items are lumped together. Such an abstract as is possible is hereto appended. By consulting the accounts for the previous year, it has been possible to make a comparison. In looking at the comparative figures, however, it is necessary to bear in mind (1) that during the past year the share capital issued has been increased by £450,000, (2) that during the second half of last year the company has been working under abnormal conditions owing to the war, many of its men and vehicles having gone to the front, and some of its works, etc., having been temporarily taken over by the War Office, (3) that no remuneration has yet been paid to the company by the Government, and (4) that during the year the company purchased the assets of the New Central Omnibus Company and the Metropolitan Steam Omnibus Company. The second of these facts would reduce the revenue below the normal, while the fourth would increase it. Thus no absolute comparison can be made, but the figures for 1913 are still of some interest when put alongside those for 1914.

MOTORS FOR MUNICIPAL SERVICE.

Steady progress is still being made in regard to the substitution of motors for horse traction in the various departments of the municipal councils in spite of the difficulty of delivery due to the demand of the War Office upon the leading manufacturers. Amongst the latest movements in this direction the following are notable:

Bradford Corporation have placed a contract with Messrs. W. A. Stevens, Limited, of Maidstone, for the supply of a petrol-electric chassis.

Walsall Corporation have placed an order with the Daimler Company, Limited, for the supply of six motor omnibuses.

London County Council have ordered two motor lorries from Messrs. Alldays and Onions, Limited.

Aldershot Urban District Council have purchased a combined water cart and motor lorry from Richard Garrett and Company.

Burton-on-Trent Town Council are applying for an order for powers to run motor omnibuses in connection with their tramways.

Portland Urban District Council are seeking authority to purchase a steam tractor.

Swansea Corporation have applied for sanction to borrow £1,135 in order to purchase a motor fire engine and escape combined.

Hendon Urban District Council have applied for powers to borrow the necessary money for the purchase of a motor fire engine.

Southampton Town Council have placed an order with Thornycroft for a motor wagon of 4 tons capacity, and also with J. and E. Hall, Limited, for a similar vehicle.

Chiswick Urban District Council have ordered two 5-ton steam lorries from the Yorkshire Steam Wagon Company, Limited, and two 3-ton petrol lorries from the Belsize Motors, Limited.

Barnes and Mortlake Urban District Councils have applied to the Local Government Board for sanction to borrow £4,000 for the purchase of four battery-driven vehicles fitted with tipping bodies.

Portland Urban District Council have decided to purchase a steam tractor and three trailers.

Batley Corporation have under consideration the purchase of a new motor fire engine.

Rochester Town Council at a recent meeting decided to purchase a motor fire engine at a cost of £1,100.

The Public Health Committee of Leigh (Lancs.) Corporation at a recent meeting decided to reconsider the purchase of a petrol motor ambulance, and a member of the committee urged the advisability of considering the Edison accumulator motor on the ground that it was less costly to run.

Richmond Town Council have decided to purchase a motor fire engine.

Loughborough Town Council decided to install a motor fire engine as soon as the new fire brigade station is complete.

Teddington District Council have applied to the Local Government Board for sanction to borrow the money for the purchase of a new motor fire engine and also for alterations to the fire station.

Liverpool Corporation have accepted the tender of Messrs. Straker-Squire (1913), Limited, for the supply of a motor ambulance.

West Bromwich Corporation have accepted the tender of Edison Accumulators, Limited, for the supply of a battery chassis.

The Manchester Corporation have placed an order with the Daimler Company for the supply of a six-cylinder motor car fitted with a landaulet body.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

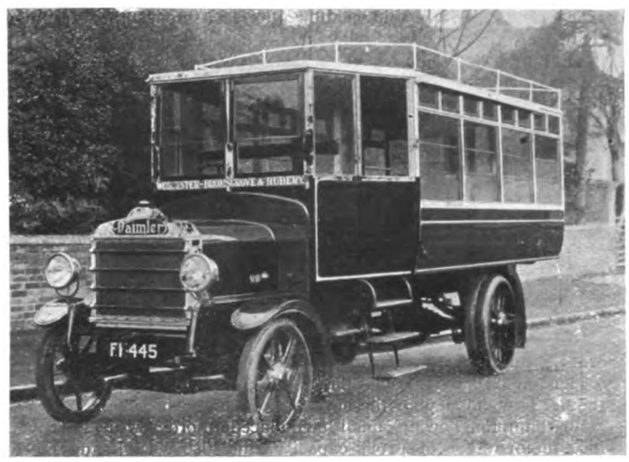
THE GREAT WESTERN RAILWAY have recently put in service 15 30-H.P. Maudslay motor cars as a result of the success of motor vans in cartage work.

FIRE AT THE DUNLOP WORKS The recent fire at the Dunlop Rubber Company's works at Aston was not of a serious character, and the company desire it to be known that it will cause no interruption of supplies.

PRIZES FOR INVADERS OF GERMANY.—The directors of the British "Berna" offer £25 to the first driver, in Government service, of a British "Berna" lorry that gets over the Rhine, and £50 to the first driver of a British "Berna" lorry that enters Berlin.

STEAM SUBSTITUTES.—At the present time when it is almost impossible to obtain delivery of 3-ton and 5-ton petrol vehicles, it is not surprising to learn that steam vehicles of reliable make are replacing to a large extent the petrol machines which have been commandeered by the war office.

PARIS MOTOR OMNIBUS SERVICE.—For the first time since the outbreak of the war, Parisians are now to enjoy the convenience of motor omnibus services. Although the war department are still retaining a large number of the vehicles for the use of the Army, the omnibus company hope to be able to maintain an efficient service on the principal routes.



Daimler Omnibuses from the British Automobile Traction Company now in Service with the Expeditionary Forces.

FODEN'S SPARKLESS STEAM WAGONS.—Giving evidence at Chichester in an unsuccessful action for damages brought against Messrs. Henry Farr, haulage contractors, for damage caused by a fire alleged to be due to sparks emitted by one of their Foden wagons, Colonel Crompton, R.E., stated that for all practical purposes the Foden wagon is incapable of emitting sparks.

A NEW 2-TON AMERICAN LORRY.—A new American-built lorry with a carrying capacity of two tons has recently been introduced to the British market by the Shakespeare Lorry Company of Bouverie Street, London. It is fitted with a 4-cylinder engine, 3¾ bore by 5½ stroke, developing 22 H.P. normal speed. The design of the machine follows the usual American practice, being built on the unit system.

THE ELECTRIC VEHICLE COMMITTEE have decided to offer, through the Commercial Motor Users' Association, prizes amounting to £10, to be awarded to electric vehicle drivers in the examination for drivers which the Association is arranging to hold this year. The General Electric Company, Limited (67, Queen Victoria Street, London, E.C.), have been appointed official manufacturers for making the standard charging station signs. The Council of the I.M.E.A. has requested the committee to prepare a report on "The Use of Electric Vehicles in Municipal Service" for discussion at the next convention.

BONUS TO WORKERS.—The Dunlop Rubber Company has issued the following notice to its workers: "In view of the increased cost of living, and with the object of encouraging their employees to do everything possible to meet the present demand, the directors have decided to pay until further notice a bonus on wages to all rubber workers, both male and female. The amount of the bonus will be 10 per cent., or 2s. in the pound, and it will be earned each week by those who have not lost more than one hour in that week except through sickness."

FROM OIL WELLS TO CAR.—The "Shell" Company has issued an illustrated booklet descriptive of the processes through which petrol has to pass from the time the original mineral oil is pumped out of the earth to the time when it is poured, in the form of refined spirit, into the user's tank. The booklet should be read with interest by all users of petrol motors, and will convince them of the great care taken by the company to insure not only that the quality of the spirit is kept up to the highest standard, but that full measure may be relied upon.

THE MONTREAL MOTOR SHOW.—The exhibition of motor vehicles in the Ford Building, Montreal, which was held from January 23 to 30, does not appear to have been altogether a success. The exhibits were very much fewer than on previous occasions, and the attendance also fell below that of the previous year. The British models shown were three in number, namely, two Halleys and one Albion, these being shown by the Canadian company in each case. There appears to be little doubt as to the superiority of the British models over all others shown at the Exhibition. This speaks well for the design and manufacture of both models.

MOTOR OMNIBUS SERVICE AT READING.—Mr. S. E. Garcke, secretary of the British Automobile Traction Company, has laid before the Tramways Committee of Reading a scheme for the running of motor coaches in the district around the town. The company proposes at first to run services between Wallingford or Streatley, Henley, Maidenhead, and Reading, and afterwards to add a service between Newbury and Reading. In his letter outlining the scheme, Mr. Garcke shows that provision has been made to avoid the possibility of competition arising between the tramways of the Corporation and the omnibuses of the company.

STANDARD WHEEL SIZES.—The Solid Tire Committee of the Society of Motor Manufacturers and Traders has appointed a sub-committee to meet the Management Committee of the Society for the purpose of deciding upon the exact wording of the reference to the mileage guarantee for solid tires. The number of sizes agreed upon is six; four of these being marked as in more general use. It was reported that the War Office now requires all American-built lorries to be fitted with wheels to British standards. Some discussion took place as to the advisability of the British tire makers making special moulds for American sizes; the general view, however, was that this should not be done.

HALLEY'S INDUSTRIAL MOTORS, LIMITED.—The report of this Company for the year ended December 31 shows that the profit on the year's working was £53,255, and, including the sum brought forward, there is a disposable balance of £58,377. Of this amount £7,001 is written off for depreciation and £15,000 is carried to the reserve fund, leaving a balance of £36,376. An interim dividend required £3,500, and the directors recommend a final dividend at the rate of 30 per cent. per annum on the old shares in respect of the last six months of 1914, making a total dividend for the year at the rate of 20 per cent. A dividend of 20 per cent. is also recommended on the new shares. These dividends absorb £12,833, leaving £20,042 to carry forward to next year, subject to directors' fees and bonus to employees.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

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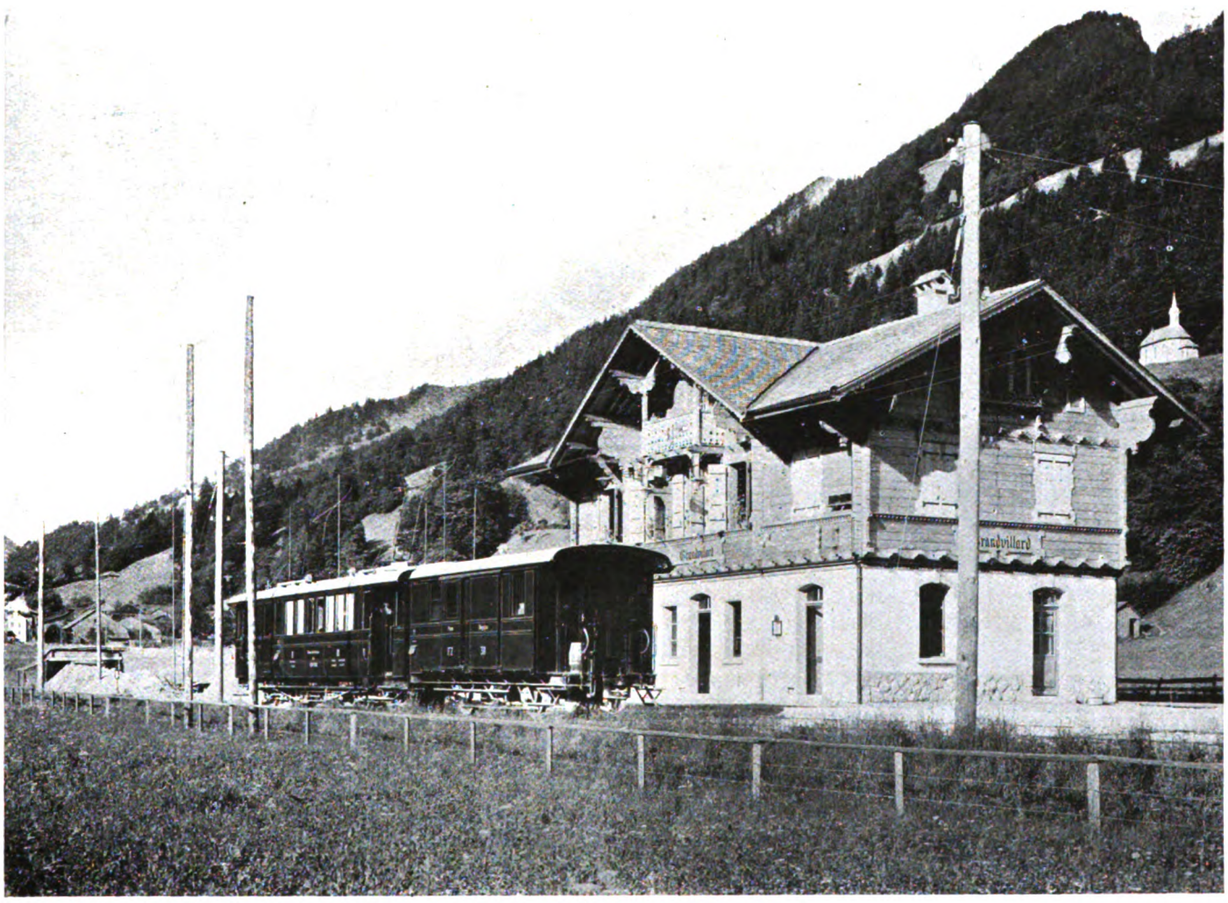
LA GRUYÈRE ELECTRIC RAILWAYS.

La Gruyère, the charming site of which affords in normal times a great attraction to tourists, is situated to the north-east of the lake of Geneva. The hilly nature of the land there has long retarded the establishment of railways, and it was only within recent years that a commencement was made in the construction of a system of railways which now aggregates more than 35 miles of track. The railway is worked by electricity, and the whole plant was provided by the "Société d'Electricité Alioth." The installation as thus designed presents numerous features of interest from a technical point of view. A large hydro-electric station at Montbovon, with a reserve station at Thusy-Hauterive, feeds the whole system by the aid of four transforming sub-stations, so arranged that the load is almost equally distributed between them. Current is received by these sub-stations at a tension of 8,000 volts. The whole service is divided into three sections. The first connects Palezieux with Chatel-St.-Denis, the second Chatel-St.-Denis and Bulle, the third Bulle with Montbovon.



Train at Grandvillard Station on La Gruyère Electric Railway.

About one-third of the whole mileage is served by each of the three sub-stations located at Semsales, Bulle and Albeuve; the fourth is at Chatel-St.-Denis.

At the Bulle sub-station there are three sets of 250 H.P. motor generators. These machines are composed of an asychronous motor fed with current at 8,000 volts, direct coupled to a generator supplying

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continuous current at a tension of from 750 to 1,000 volts. Both the generator and the motor are of the Alioth type. The station includes a battery of accumulators of 375 cells, the capacity being 370 ampere-hours. The three sub-stations of Chatel-St.-Denis, Albeuve, and Semsales were originally provided with two 70 KW. motor generators; floor space being reserved for the installation of a third group of the same power. They are erected in buildings 57 ft. long, 33 ft. wide, and 16 ft. 6 in. in height. These buildings contain the engine room, the battery of accumulators, the transformer room, a small store, and the high tension apparatus. The train service is carried on with a somewhat restricted number of very heavy trains. In order to equalise the load, use has consequently to be made of suitable batteries of accumulators.

Each motor generator, in the three last sub-stations, comprises a three-phase asychronous motor coupled direct to a continuous current generator, both of them being of the Alioth type. Each unit is of 100 H.P. and works at 500 volts; the speed of rotation is 580 revolutions, at which speed the frequency amounts to 50. The current is subjected to a primary transformation to 500 volts in Alioth static transformers, whereby its tension is reduced and it is conveyed by the conductors to the sub-stations, where it is converted. At Bulle sub-station, however, which is the most important, the motor generators are fed at a tension of 8,000 volts.

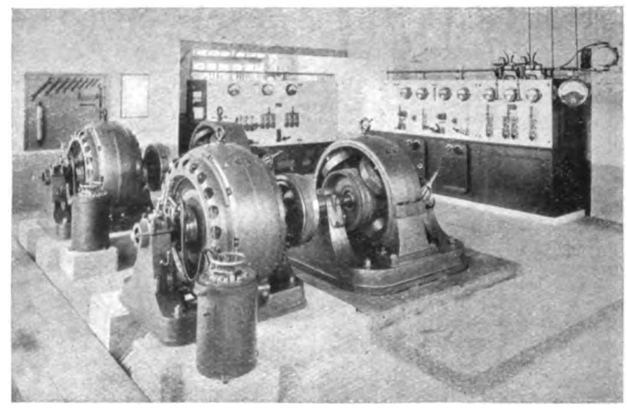
Each sub-station has a small battery of 375 cells with a capacity of 115 ampere-hours. These accumulators can be discharged in a period of one hour.

The switch boards are formed of white marble panels, mounted upon a wrought-iron frame with sheet-iron walls. The continuous-current board comprises four panels, one provided with three amperemeters for measuring the current from the battery and from two leads, whilst a general voltmeter is also arranged upon this panel; the others are for the generators forming the three groups. These panels are also fitted with the usual switch and measuring devices. The three-phase board comprises three panels, each belonging to one group, and fitted with oil switches, amperemeters, and three-pole switches and cut-outs, these two latter for insulating the transformers from the primary and secondary side. The two portions (continuous and three-phase current) are separated from each other, but are arranged in such a way that the operator always has a clear view of them. The distribution of the current between the battery and the line is regulated automatically. The dynamo charges the battery exclusively when no current is required by the line. In proportion as the charge on this latter increases, the current distributed between the line and the battery increases towards the line; at the same time the voltage decreases at the terminals of the dynamo. It thus happens that the voltage is no longer sufficient to feed the battery which discharges itself upon the line which then receives its energy simultaneously from the battery and the dynamo. After reduction of the high voltage and transformation to continuous current in the sub-stations, the energy is sent to its destination over a hard drawn copper wire of high conductivity, measuring 9 mm. in diameter.

The feeders, distributed as stated below, are electrically connected to the contact wire every 1,320 ft. The total loss in the circuit, supposing three trains to be running one after the other, does not exceed 12 per cent. Between Chatel-St.-Denis and Semsales (4·5 miles) the first feeder is composed of two leads of 11 mm. diameter, or altogether a section of 254 sq. mm. The second, between Semsales and Bulle (eight miles) is provided with a 9 mm. lead, or altogether a section of 125 sq. mm. The third, between Bulle and Albeuve (eight miles), consists of two leads of 8 mm. and 6·7 mm. respectively, or altogether a section of 147 sq. mm. Finally, the fourth, between Albeuve and Montbovon (2·9 miles), is composed of a lead of 6·7 mm. diameter, or altogether a section of 98 sq. mm. The system is of the overhead wire type with return through the rails. The line is divided into sections of 5,280 ft. in length. Each section is separated from the section immediately adjacent by means of a special switch.

At junction points the wire is suspended by means of tightening devices and bell insulators, whilst in straight sections poles are used with brackets of special construction; at curves double poles are used with cappings and stretchers. In all cases the points of suspension are arranged according to the axis of the track. The current is taken by means of a bow trolley, the frictional part being formed of an aluminium bar, the whole arrangement being so carried out that the wear and tear of the bar are reduced to a minimum. Where the track is perfectly open the height from the wire (lower edge) to the rail (upper edge) amounts to 16 ft. 2½ in.; towards roads and crossings the height is 19 ft. 9½ in.; at the stations it is 20 ft. 10 in.

The brackets and the distance between the posts are calculated in such a way that the minimum distance



Typical Sub-Station—La Gruyère Railway.

from the wall of the car to the axis of the post is 24 in., whilst the yokes cannot quit the contact line. The supporting posts, which are of well impregnated wood, are placed at a distance of from 66 ft. to 132 ft. (66 ft. at curves). They are 26 ft., 30 ft., and 33 ft. in height, and are sunk into the earth to a depth of 4 ft. and 5 ft. 6 in. Every third or fourth post is fitted with a lightning conductor. As mentioned above, the return is effected by means of the rail, which is of the Vignoles type (45 lb. per yard), on the independent right of way. On sections of the line at Palezieux, Montbovon, and Albeuve it is about double the weight, and of the Phœnix type. The track rests upon a ballasted permanent way of 6 ft. 6 in. breadth at the top by 1 ft. thick. Oak or white pine sleepers have been used. These are placed at intervals of 2 ft. 8 in., and are well impregnated with chloride of zinc at 1/60. The distance between the inner edges of the rails is 3 ft. 3 in.

Electrical connection between the rails is made by solid copper bonds, so that no preliminary perforation of the rail was required. The ends of the rail are first scaled and cleaned; upon these ends there is then fitted a copper plate of 0·155 sq. in. section and covered with a plastic amalgam. The whole is kept rigid by means of the ordinary bracket joints. The two rails together correspond to an approximate section of about 1·49 sq. in. Every 660 ft. a copper wire, soldered to the two ends, establishes a cross connection.

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The line has only a single track over nearly the whole of its length, but there are two tracks at a few sheds, crossings, stations, etc. Owing to the varying intensity of the traffic, both motor cars and trailer cars are used, and the trains are made up as required by the traffic. The roofs and floors of the cars are of pine, whilst the framework is of oak. The sides are of sheet iron of 1/16 in. thickness.

The motor cars for long trains weighing up to 130 tons, have four axles and are fitted with four 80 H.P. motors. Some other motor cars have four 35 H.P. motors for trains of 47 tons (passengers) or 60 tons (goods). The power of the motors may, in exceptional instances, be increased to 50 H.P. These powers were selected with a view to obtaining on gradients a speed of 10 miles for long trains, 12 miles for small passenger trains, and 10 miles for goods trains. None of the gradients exceeds 3·2 per cent. As regards the curves, the minimum radius allowed is 495 ft. at those parts where the gradient is less than 1 in 40, whilst it is 330 ft. at those parts where the gradient is above 1 in 40.

The potential is 750 volts, but the 35 H.P. motors are only wound for half this voltage; they are, as a matter of fact, arranged in groups of two, and the two groups, formed of two motors in series, may be connected in parallel for normal working, or else in series in the case of heavy gradients. As regards the 80 H.P. motors, these utilise the whole of the voltage, being grouped in pairs of two in parallel, the two pairs being adapted to work either in series or in parallel.

In order to enhance the stability of the trucks and reduce wear and tear by decreasing the effect of the centrifugal force over curves, the motors are mounted inside the axles. The motors make 550 revolutions per minute, and drive the axles by the aid of a pair of skew spur-wheels. The speed is reduced by 1/5 in the case of mixed coaches, and by 1/4·2 in cars intended for passengers solely. The motors are provided with the necessary glazed ports, notably for access to the brushes of which there are two, with three carbons, which make contact with a large sized commutator. A special arrangement is provided for preventing oil from being splashed out of the bearings. Control is obtained by means of an Alioth governor with a magnetic coil which enables the train to continue running, even should an accident happen to one of the motors, with all the motors remaining in series. It stops the motors by short-circuiting them. The motors then act as generators, whereby good braking effect is obtained. A series motor, started by a small regulator, operates a pump which feeds all the Hardy vacuum brakes on the whole train.

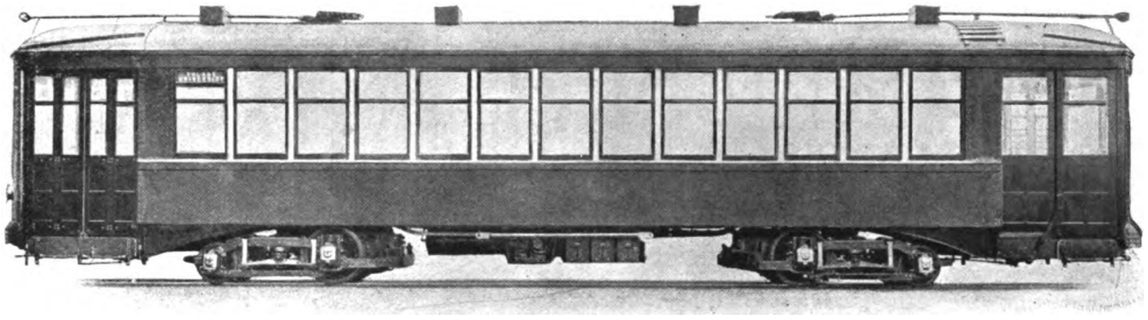
French Import Duties on Rails.—A Reuter's telegram states that a decree has been issued suspending the French import duties on rails and fishplates intended for the repair of lines which are being used for national defence.

ALL-STEEL CARS IN NEW ORLEANS.

An interesting type of car has been adopted in New Orleans after a study of various kinds of cars, of the conditions in which they worked, and of the conditions to be met with in New Orleans. As a result there was chosen the double-truck, two-motor, double end, arch roof car, fitted with enclosed platforms, which is shown in the accompanying illustrations. For these and for the following descriptive matter we are indebted to *(Electric Traction)* of Chicago.

The principal dimensions of the car are as follows: Length over corner posts, 34 ft. 8 in.; length over bumpers, 47 ft. 8 in.; width over all at window rail, 8 ft. 7 in.; width over eave mould, 8 ft. 5¾ in.; height from top of rail to top of trolley board, 11 ft. 3⅜ in.; truck centres, 23 ft. 5¼ in.; wheel base of truck, 4 ft. 10 in. The car is provided with 18 cross seats of the walkover type and stationary longitudinal seats at the end of the car, each holding four seated passengers, giving a total seating capacity of 52.

As it was desired to provide an easily accessible car, 30 in. wheels were selected for the trucks, and the body hung as low as possible. The first step is 13⅝ in. from the rail level, the second step is 11 in. to the top of the platform. A 7¾ in. step brings one to the car floor, at the end sill, and from this point a ramp of 3¼ in. up to the bolster, brings the total height of the top of the car body floor 35⅝ in. above the rail, without passenger load.



All-Steel Prepayment Car—New Orleans Tramways.

The general arrangement gives enclosed platforms at both ends of the car, these platforms being 6 ft. 2 in. long from front of vestibule dash to corner posts, and 6 ft. 6 in. long from front of buffer bar to the corner posts. At the ends of the car longitudinal seats, each seating four passengers, are placed so as to give maximum floor space near the platforms. In the body of the car there are 18 reversible wooden slat cross seats. The main aisle is 26 in. wide between seat ends, and 29 in. wide between seat backs. The aisle space at longitudinal seats is 57 in.

The platform is fully enclosed by means of double folding doors on the entrance side, and single sliding doors on the exit side. All doors are interconnected with their respective steps, so that on closure of the door its step is folded up simultaneously. The entrance or folding doors give a clear opening of 54 in. when open, this opening being divided into entrance and exit portions by the installation of a vertical enamelled pipe, approximately in the centre of the space. The door operating stand is located on the centre line of the car, and 11½ in. from the end sill, leaving room for the conductor to stand between it and the end sill. A portable and adjustable seat is furnished for the conductor's use, also one for the motor man. The door and step operating mechanism is of Burdette-Rowntree manufacture. Enamelled stanchions are provided at

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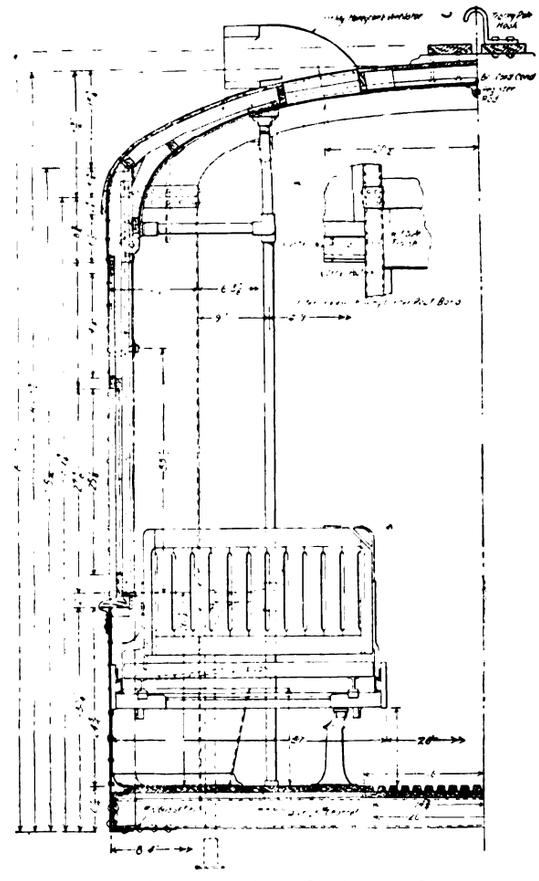
the entrance archway and at the entrance and exit doors, in such a way as to encourage passengers to take the proper hand-hold in boarding and alighting, so as to minimise accidents arising from this source. Instead of hand straps in the body of the car, enamelled hand rails are arranged over the longitudinal seats in a convenient manner for hand-hold. These enamelled hand rails and stanchions are coated with a glass-hard enamel baked at high temperature, these being furnished by the Ellcon Company.

The car is built of steel throughout with the exception of the floor and roof. The underframe consists of two girders made up of No. 12 gauge steel plates, 30 in. wide and 34 ft. 8 in. long when assembled. The top member of this girder is a $3\frac{1}{2}$ by 1 by $\frac{3}{8}$ in. dropper bar, and the bottom member is a 4 by 3 by $\frac{5}{16}$ in. angle. Two splice plates were necessary in the length of this girder, and it is reinforced at the bolsters by means of an extra angle, 4 by 5 by $\frac{3}{8}$ in. and a $4\frac{1}{2}$ by 3 by $\frac{3}{8}$ in. vertical tee, securely riveted to the girder web. The bottom member of the side of the girder is bent at the end sills so as to meet at the centre line of the car, where it is spliced together, and the end sills are further made up of a $\frac{3}{16}$ by $9\frac{1}{2}$ in. plate securely riveted to the above angle, and reinforced on the bottom with a $3\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{1}{4}$ in. angle. Frequent crossings composed of 4 in., 5·25 lb. channel fasten the two girders together, and the underframe is further stiffened by the use of diagonal members consisting of steel bars $2\frac{1}{2}$ by $\frac{1}{4}$ in. Generous gusset plates are fastened to bottom angle and crossing channels. The top angle of the girder is covered with an oak window rail which also furnishes an arm rest on the inside of car.

The main platform knees are made up of a flat plate, No. 10 gauge, cut to the contour shown, and reinforced on one side by means of $2\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{1}{4}$ in. and $3\frac{1}{2}$ by $2\frac{1}{2}$ by $\frac{1}{4}$ in. angles. These platform knees are securely riveted to the end sills and cast steel body bolster, no bolts being used. The platform knees terminate at and are riveted to a 7 in. section of channel-shaped Hedley anti-climber. The auxiliary platform knees consist of a 4 in. channel bent to the proper shape, riveted to the end sill and body bolsters.

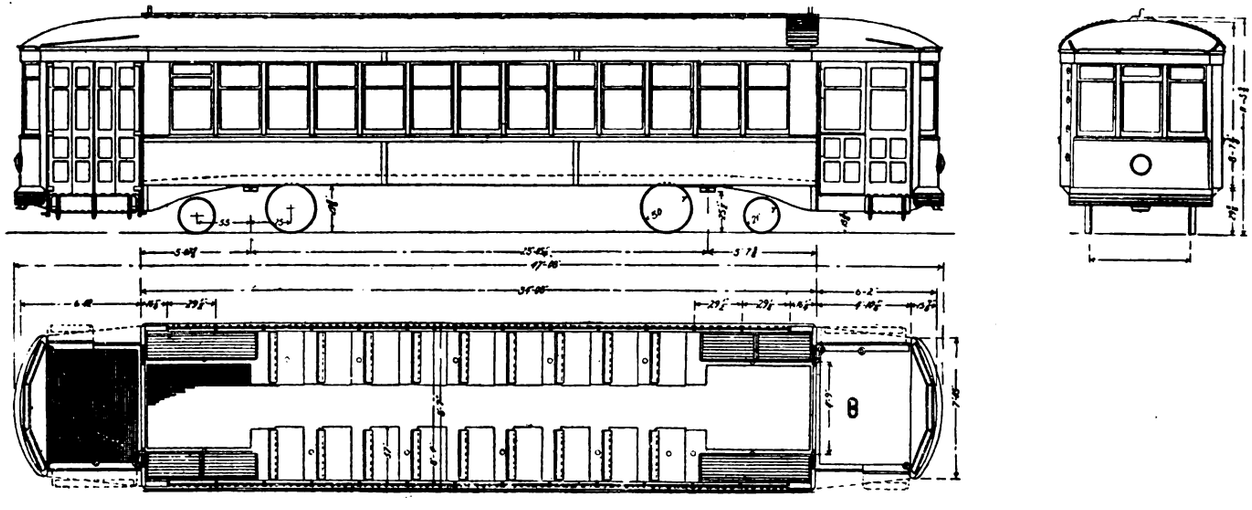
The car posts are made of No. 16 gauge sheet steel, pressed in a "U" shape, the flanges of which are securely riveted to the side girder, same being capped above the side girder with a No. 16 gauge plate riveted on the outside. The inside of the post is covered by a No. 18 gauge sheet steel, shaped so as to take the rack for the window fasteners, and provide ways for the curtain fixtures, being fastened to the post by means of hollow screws.

The carlines are composed of a pressed "U" shape



Half Cross-Section of All-Steel Car.

section, and are securely riveted and bolted to the top of the posts, the carlines fitting inside of the posts. The end headers and corner posts consist of pressed steel sections of a deep "U" shape, being riveted together at the spring line of the arch of the header and further riveted to the side girder and pier panel, which extends between corner post and first side post. The headers are furred with wooden furring strips, and



Plan and Elevation of All-Steel Car—New Orleans Tramways.

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the roof boards are through bolted to these furring strips and to the flanges of the carlines.

The vestibule posts are all of pressed steel, the two centre posts being made in one section of No. 16 gauge steel, while the corner vestibule posts are made in two sections of No. 12 gauge steel, securely riveted together. These posts are bolted to an angle iron sprung to the proper radius and fastened to the oak crown piece. The vestibule is made of No. 16 gauge sheets bolted to the vestibule posts and also a lining plate on the inside of the vestibule posts, which provide a pocket for the sash to lower into. The outside of the vestibule is provided with the usual bumper shield.

The letter-board is continuous through the whole length of the car body and around the vestibules. Through the car body it is reinforced between posts with a $\frac{3}{4}$ by $\frac{3}{4}$ by $\frac{1}{8}$ in. angle. Through the length of the car body the letter-board is 16 in. wide and is riveted not only to the posts but bent over to the arch of the roof and riveted to the carlines. The vestibule top plates consist of a $2\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{4}$ in. angle continuous from body corner post to body corner post.

The floor consists of tongued and grooved yellow pine plank, laid lengthwise of the car and depressed at the aisle section so that the top of the floor mat is level with the top of the floor at the side seats. The floor mats consist of narrow strips of maple screwed to the flooring.

The roof consists of $\frac{1}{2}$ in. tongued and grooved poplar plank, through bolted to the carlines and covered with No. 8 canvas duck. The drip rail is made up of wood and bolted to the letter-board; the canvas of the roof comes down over the upper part of this drip rail and is tacked with copper tacks, following steam railroad practice. This drip rail is continuous around vestibules. The curtain box is formed out of No. 22 gauge steel in sections covering one curtain and arranged for ready removal for access to curtains and fixtures.

The headlining consists of $\frac{3}{16}$ in. Agasote in convenient sections, the joints of which are covered with light cherry moulding, this moulding matching that carrying the lighting wires through the body of the car. The bottom sash is arranged to be lifted so as to give a clear opening of $27\frac{1}{2}$ in. The top sash is fastened to the post caps with screws installed from the outside of car.

The interior finish is dark cherry colour throughout, the headlining being painted a light green colour. The interior of the car is rubbed down to a dull finish after varnishing and presents a very neat and attractive appearance, the finish of the steel making a very good match with the woodwork of the seats and mouldings.

The outside of the car is painted a light olive green, and the only striping or lettering is on the dash and consists of the car number and an aluminium stripe around the edge of the dash plates.

Ventilation is provided by means of eight suction ventilators. The seats are the standard Hale and Kilburn 300 type fitted with wooden cushions and backs. The Consolidated push button system is used for signalling to the motorman. The side curtains are of Pantasote fitted with Forsythe Rex type rollers. Motorman's curtains are also provided. The bell cord to motorman's signal bell is run in conduit above the headlining. The lighting layout provides four circuits of five lights each, giving 20 lights using the 23-watt tungsten lamp. A very neat and convenient arrangement for the light switches is provided by the installation of a switch cabinet in the pier panel of No. 1 end of the car. The door of this cabinet is flush with the interior trim and the cabinet contains all the switches except those for the compressor, these being located on the dash convenient for the motorman. The compressor switches are wired in parallel so that passengers on the rear platform cannot inadvertently cut off the compressor circuit.

The service conditions under which these cars operate are as follows: Schedule speed, 10·8 miles per hour; average stops per mile, 7·25; average duration of stops, 4·5 sec.; average line potential, 510 volts; rate of accelerating and braking, $1\frac{1}{2}$ miles per hour per second; average passenger load, 4,500 lb.

The total weight of the car, fully equipped ready to run, is 34,500 lb. This weight is made up as follows: Two maximum traction trucks, complete with wheels, axles, frame, boxes, and brake rigging, 10,200 lb.; electrical equipment on trucks, consisting of motors, gears, and gear case, 5,800 lb.; electrical equipment on body, including controllers, cables, circuit breakers, trolley bases, poles, etc., 1,300 lb.; air and hand brake rigging, 1,800 lb.; car body, complete, including all accessories, 15,400 lb.

The trucks are Brill 39-E maximum traction type, fitted with 30 in. driving wheels and 21 in. pony wheels, having a wheel base of 4 ft. 10 in. The wheel tread is the standard American Electric Railway Association tread "B," with $\frac{3}{8}$ in. flange and $2\frac{1}{2}$ in. tread. The wheels are of the single plate type, and made of cast iron. The truck bolster is provided with an auxiliary spring placed between it and the elliptical side spring, which provide easy riding under conditions of partial load. The usual form of journal box and motor suspension springs are provided. Journal boxes are Brill type semi-steel.

The car is equipped with two GE motors of 55·65 H.P., the gear ratio being 15-71. All power wiring is carried in conduit. Solid gears and pinions are used, the face of gears being 5 in. These are pressed on the axle at approximately 60 tons pressure.

The car is fitted with complete Westinghouse straight air brake equipment. The body and truck brake levers are so arranged as to give a braking pressure of 75 per cent. of the load on the pony wheels, and 85 per cent. of the load on the motor wheels, which was considered to meet the service conditions at New Orleans satisfactorily. Hand brakes arranged with double floating levers and ratchet type brake handle are provided.

The design of the car, selection of equipment, and specification were made by the United Gas and Electric Engineering Corporation, engineers for the New Orleans Railway and Light Company.

PROPOSED LIMIT ON WAR PROFITS.

The Government propose to limit the profits of all important firms engaged wholly or mainly on engineering and shipbuilding work for war purposes. The Board of Trade announced on March 27 that at a meeting at the Treasury on the previous day with Mr. Lloyd George and Mr. Runciman, representatives of the Amalgamated Society of Engineers resolved that in view of the explanation of the Chancellor of the Exchequer the agreement with the trade unions for the acceleration of output on Government work be accepted by the union. The Chancellor stated that it was the intention of the Government to conclude arrangements with all important firms engaged wholly or mainly upon engineering and shipbuilding work for war purposes, with a view to securing that benefit resulting from the relaxation of trade restrictions or practices shall accrue to the State; the relaxation of trade practices contemplated in the agreement would relate solely to work done for war purposes during the war period. In the case of the introduction of new inventions which were not in existence in the pre-war period, the class of workman to be employed on this work after the war would be determined according to the practice prevailing before the war in the case of the class of work most nearly analogous. On demand by the workmen, the Government department concerned will be prepared to certify whether the work in question is needed for war purposes. The Government will undertake to use its influence to secure the restoration of previous conditions in every case after the war.

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THREE-PHASE LOCOMOTIVES FOR ITALIAN STATE RAILWAYS.

The Società Italiana Westinghouse, which has recently been acquired by the British Westinghouse Company, is now delivering to the Italian State Railways 16 three-phase locomotives. These new machines have two 3,300-volt, 16·7 cycle induction motors of 1,300-H.P. each, of the slip-ring type. The stator windings are designed so that the coils can be grouped either for two-phase, six poles, or three-phase, eight poles. Similarly the rotor has a special winding which can be connected for either two-

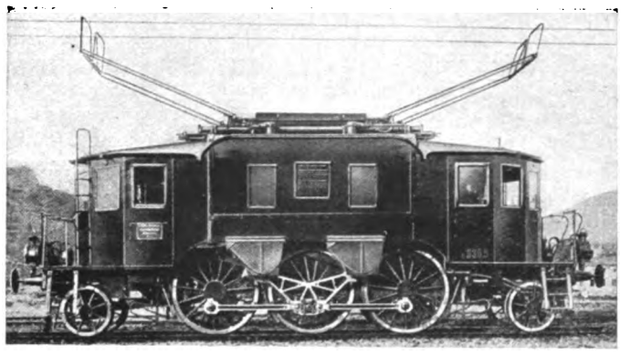

Fig. 1.—Three-Phase Passenger Locomotive—capacity 2,600 h.p.

phase, six poles, or three-phase, eight poles. Only seven slip rings are required. A group of three or a group of four of the seven slip rings can be connected to the stator of the second motor when a three-phase, eight pole, or two-phase, six pole cascade is required. Otherwise they can be short-circuited through the water rheostat when the motors are connected in parallel to the line. The two motors are connected mechanically.

By connecting the motors in parallel on the line (connected either for two-phase, six poles, or three-phase, eight poles), or connecting them in cascade, a four-speed combination can be obtained which at 16·7 cycles with a wheel diameter of 1·63 m. (64·2 in.), gives four running speeds of 23·3, 31, 46·6, and 62-M.P.H. These are sufficient for passenger service locomotives, not only on level lines, but also on fairly high grades.

The change of the motor connections from parallel to cascade and also from six to eight poles, two or three-phase, is made by a drum type controller operated through electro-pneumatic relays by a master controller. The method of starting the wound-rotor induction motor is by means of a liquid rheostat with an automatic regulation feature which increases or decreases automatically the amount of resistance inserted in the rotor, so as to keep the power absorbed from the line fixed at a predetermined value. It is also supplied with a motor driven centrifugal pump which is inserted in the line as soon as the rheostat is in operation. This pump throws a jet of water against the resistance plates to prevent concentration of heat at the surface of the water, so all the water assumes an even temperature.

The automatic regulator is designed to regulate for constant watts instead of constant current, as was the case in the older type of rheostat. The regulator consists of a laminated core with a two-pole winding connected in series on the ground phase of the motor and constituting the stator, and of a double T-shaped rotor with a winding inserted between the other two phases.

The torque exerted between stator and rotor is counterbalanced by a spring, and the tension of this spring can be regulated by the starting controller operated by the motorman so as to predetermine the amount of power to be absorbed from the line by the motors. When the power absorbed by the motor exceeds a predetermined value, the regulator tends to rotate in one direction, thereby increasing the resistance inserted in the rotor which in its turn decreases the power absorbed; *vice versa*, when the power absorbed tends to decrease the regulator rotates in the other direction, thus keeping the amount of power taken by the motor at a constant value. Besides the controller and liquid rheostat, the locomotive is equipped with the usual auxiliary apparatus and instruments. There is, however, in addition a small transformer to change the power supply from three to two-phase.

Fig. 3 shows the connection between the overhead line and the primary switch through the trolley, impedance coils, and oil switch; also the circuit supplying the auxiliary apparatus with fuses, lightning arresters, and transformers. The three phases consist of two overhead wires and the rails or ground phase. There are, as already mentioned, four connections of windings and motors to obtain the four running speeds. Two connections are shown in Fig. 4; that is, the three-phase, eight-pole cascade and the two-phase, six-pole parallel. All of these connections are made by the controllers, which are never operated under load. The connections from the slip rings to the water rheostat are shown in Fig. 5. The water level, rising in the rheostat, fills the space between the plates, thus short-circuiting the rotor windings, which are connected to the plates as shown. The controller, the trolley, and the liquid rheostat are operated by compressed air supplied by a small three-phase motor and compressor,

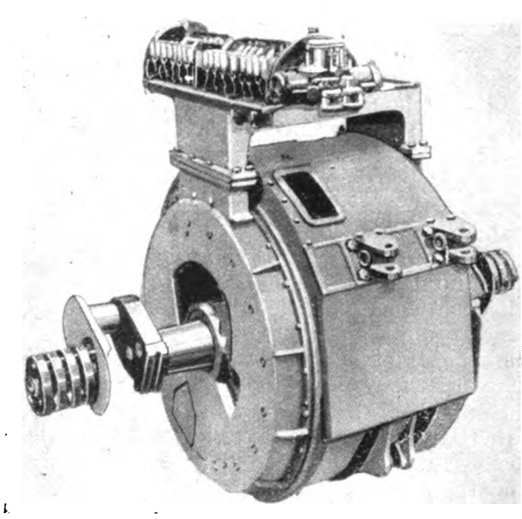

Fig. 2.—Three-Phase, 3,300 volt Motor of Passenger Locomotive.

which also supplies the air for the two air brakes (the automatic and straight air brakes).

The motors are well ventilated with air circulation through the stator iron and winding. The stator end connections are dipped in an insulating compound, and then covered with a brass plate to prevent damage. Experience has shown that this construction has done away with insulation break-downs due to moisture and vibration caused by heavy currents at starting.

This locomotive has five axles, and is of the 2-6-2 type, that is to say, two axles are supporting axles and the other three are driving. The two supporting axles

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are placed one at each end of the locomotive, and each is connected to the driving axle, next to it so as to form a kind of truck. All three driving axles have a transverse play for easy operation on curves. The slip rings are outside the wheel base and easily accessible.

The weight of the locomotive, complete, is 73 metric tons, of which 45 to 51 tons is adhesive weight.

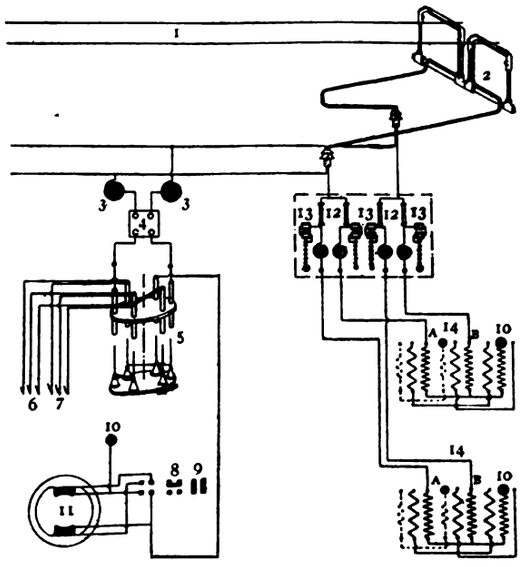

Fig. 3.—Wiring Diagram Showing Connections from the Trolley to the Motor Switch.

1, Contact Wires; 2, Trolley; 3, Inductance Coils; 4, Automatic Circuit Breakers; 5, Primary Switch; 6 and 7, to Motor Primaries; 8 and 9, Connections of Automatic Regulator for Cascade and Parallel Connection, respectively; 10, Ground Connections; 11, Stationary Part of Automatic Regulator; 12, Fuses; 13, Lightning Arresters; 14, Transformers with Primary A and B, respectively.

The weight on the drivers can be changed within these figures by an arrangement which shifts the weight from the drivers to the supporting axles. The weight and dimensions of the locomotive are given in Table I.

TABLE I.—WEIGHTS AND DIMENSIONS.

Mechanical equipment	30,650 kg.	67,500 lb.
Items.	Weights.	
Motor equipment	27,270 kg.	60,000 lb.
Mechanical equipment	30,650 kg.	67,500 lb.
Control equipment	12,700 kg.	28,000 lb.
Air-brake equipment	2,300 kg.	5,050 lb.
Items.	Dimensions.	
Maximum width	3·05 m.	120 in.
Maximum length	11·00 m.	434 in.
Diameter of driving wheels ..	1·63 m.	64 in.
Diameter of pony truck wheels ..	0·93 m.	37·8 in.

designed for the Giovi subsidiary line and for the Monza-Lecco line, which connects Milan to the Lake of Como and the Valtellina lines which were electrified in 1901 with the same system. The Monza line is level single-track, while the Giovi subsidiary is double-track and has fairly high grades, reaching 1·6 per cent. in the open, and 1·16 in a 5·2 mile tunnel.

Some figures regarding the performance and tests of this type of locomotive have been published. The normal rating of the two motors is 2,600 H.P. at three-phase, 16 2-3 cycles, 3,300 volts, and is such that the locomotive can develop for one hour continuously the draw-bar pulls given in Table II., with a motor temperature rise not exceeding 75 deg. C.

TABLE II.—RELATIONS BETWEEN DRAWBAR PULL AND SPEED.

Drawbar Pull.		Speed.	
9,000 kgm.	19,800 lbs.	37·5 km.p.h.	23·3 m.p.h.
9,000 kgm.	19,800 lbs.	50 km.p.h.	31 m.p.h.
9,500 kgm.	20,900 lbs.	75 km.p.h.	46·6 m.p.h.
6,000 kgm.	13,200 lbs.	100 km.p.h.	62 m.p.h.

This locomotive can start a train of 350 tons (exclusive of locomotive) and bring it up to 75 KM. P.H. (46·6 M.P.H.) speed on a straight line, having a grade of 1·2 per cent., with acceleration of 0·15 KM. (0·093 mile) per hour per second; the tractive effort at starting is such as to utilise fully the adhesion between zero and 75 KM. (46·6 miles) per hour speed.

Of these locomotives the Italiana Westinghouse Company has already built 16, and their operation is very satisfactory. They are run regenerating on the down grades, in this way greatly reducing the operating expenses. Their cost compares favourably with the

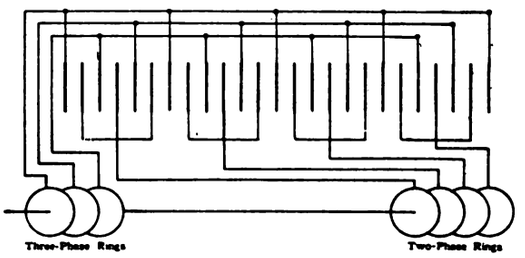

Fig. 5.—Liquid Rheostat Connection from Motor Slip Rings.

cost of electric locomotives in the United States; however, the ratio of horse power to weight, or 2,600:73, is considerably higher.

These locomotives are rapidly solving the problems of high-speed freight and passenger service on the lines

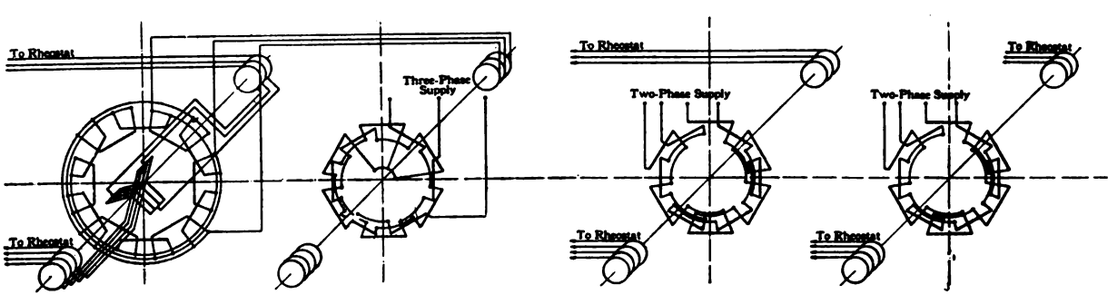

Fig. 4.—Typical Motor Connections of Three-Phase Passenger Locomotive—Italian State Railways.

The motors are mounted on the frame in such a way that the air gap of the motor can be kept as small as electrical considerations will permit. This is done by making the bearings which support the rotor rigid with the stator frame, and independent of those which support the revolving shaft. The locomotives are on which they have been installed. Some doubts were expressed some time ago as regards the overhead line having two wires. However, no trouble has been experienced, although the overhead construction with sliding pantograph would be considered rather light in this country for such service.

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LONDON, APRIL 15, 1915.

Bursting of Fly-Wheels.

The bursting of a flywheel of one of the engines in the Cardiff power station on March 21 largely wrecked the premises, and for several days the tramway service was wholly stopped or seriously interrupted. There are a number of other units in the building, and it does not appear that any of them were much damaged, but some of the water supply pipes were smashed and there were injuries to the switchboard. Holes were driven through the walls and roof by the flying pieces of the wheel, and one section of the latter weighing a ton was reported to have been found in a garden 100 yards away. Fortunately no one was injured, but that was simply because no one happened to be in the line of escape of any of the whisked-off pieces of wheel. It is said that an engineer started the engine and went immediately to attend to another, that while he was doing so the first engine accelerated to the point of racing, and that before anything could be done the fly-wheel went. These matters are no doubt receiving further investigation. It will be interesting to learn what had happened to the engine governor, how the dynamo coupled to the engine behaved, and what reception the switchgear and circuit breakers gave to the action of the run-away engine. The latter appears to have been in use for some years, but apparently there is no need to question the soundness of the fly-wheel. It was being raced far above its designed speed, and one has only to increase the speed sufficiently to burst any fly-wheel.

* * *

The incident recalls the days of long ago when the fracture of fly-wheels, especially in the United States, was not an infrequent occurrence. We do not recall any serious accident of the sort within recent years in this country. But the scare which arose some years ago owing to the bursting of fly-wheels in foreign countries led to the adoption of certain extraordinary precautions in a London power station, the concrete embodiments of which precautions are still fully visible to anyone who pays a visit to the City and South London Railway generating station at Stockwell. At that time the practice was, and no doubt still is where large fly-wheels are used, to build up the heavy rim of the wheel in segments. The binding together of these segments was reinforced by connecting them by large bolts of approximately dumb-bell section sunk flush into the wheel. The latter was open-spoked. To secure an even turning movement with a two or even a three-cylinder engine running at, say, 95 revolutions per minute, the wheel had to be of large size and to have a very heavy rim. Thus there might be a wheel of 12 ft. or more in diameter and weighing 60 or 80 tons. Taking a wheel circumference of 40 ft. and a speed of 95 revolutions per minute, a peripheral velocity of 3,800 ft. per minute is obtained, a speed involving very severe centrifugal stresses and resulting in a wreck if the rim of the wheel should open. The management of the City and South London Railway determined to take no risks of that sort. All their previous engines were high-speed vertical, but an extension to the railway requiring more power, two large horizontal slow-speed cross-compound engines were installed. The big fly-wheels necessary, instead of being of the spoked type, are disc wheels, the whole of the space between the axle and the rim being filled in with boiler plate riveted together, and holding the rim in all round. The object of safety was fully attained, but the means adopted does not seem to have

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been largely copied elsewhere. Good work and material on orthodox lines appears to have been relied upon, and not in vain. Now that all new units of large size in a power station are of the turbine type, fly-wheels are, of course, no longer necessary. There are no intermittent impulses as in the case of a reciprocating engine, but a steady turning moment. Any large and sudden fluctuation in load has to be dealt with by the governor and by the fly-wheel action of the rotor of the turbine. The rotor has not the same tendency to fly to pieces.

A Dangerous Tendency.

The idea that municipal tramways are commercial undertakings seems to be in some danger of being replaced by the view that, as these undertakings are publicly owned and controlled, they should be worked with a view mainly to their public utility. If this policy were to be accepted it would follow, of course, that ratepayers all over the country would soon be called upon to provide large subsidies in order that tramway passengers might travel at less than the cost of their carriage. Fortunately, the great majority of the members of local authorities controlling tramways are staunch adherents of a business-like policy, and mean to insist that, while a passenger shall receive good value for his fare, he must pay a reasonable price for the service he receives. There are, however, notable exceptions, as we have had occasion from time to time to point out. The latest example is Ilford, on the eastern outskirts of the metropolis. In a report on halfpenny fares, given elsewhere in this issue, the manager very properly assumes that the Ilford Tramways Committee wish to make the undertaking pay its way and to prevent it becoming a burden on the rates. He shows by statistics and calculations, accurate and irrefutable, that the only way to make Ilford tramways pay their way is to abolish halfpenny fares. The opinions of the managers of eighty leading tramway undertakings in the country strongly support this view. Yet the Ilford Council have refused to accept their manager's recommendation, and they have resolved to continue the unremunerative halfpenny fares. Another aspect of what is really the same problem appears in the recent resolution of the Aberdeen Town Council to abandon the "pay-as-you-enter" cars, in obedience to popular clamour. In both cases, the Town Councils are composed of business men, but it is evident that their decisions have not been taken on purely business grounds. They appear to think that the tramway service has become a public utility rather than a commercial undertaking, and do not realise that it should be both. Acceptance of their idea would alter vitally the responsibility which tramway managers hold to the finances of tramway undertakings. When for "reasons of public policy," which means a surrender to the demand of a section of the public, a tramway authority reduces fares, or makes other concessions calculated to impair the financial stability of the undertaking, the tramway management must be relieved of responsibility for the results. In such circumstances, the position of the manager is changed from that of director and controller of the undertaking to something like that of an expert employee, charged only with the traffic working of the concern. We are glad to think that not many of the Councils of large cities and boroughs in this country are willing to fly in the face of expert advice. Otherwise, the only logical course for them is to declare the tramways to be a non-revenue producing undertaking, like sewers, for instance, to abolish fares, and to throw the whole undertaking on the rates.

Edinburgh Eccentricities.

The Town Council of Edinburgh, or a part of it, has for years been in a state of unrest over the tramway system of the city. Financially the Council does not seem to know when it is well off, seeing that it gets a rent of 7 per cent. per annum on its tramway capital expenditure from the company which works the lines. But there has been a desire to extend the tramways further into the country, in districts where the traffic would be so small that it would be inadvisable to use the cable system. A separate company got powers a year or two ago to construct south-west suburban tramways on the electric trolly wire system, but they have not yet been built. During the past month a Provisional Order promoted by the Corporation for lines in the same district failed

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badly. It has now been agreed by a special committee of the Corporation to make an experiment with some sort of self-propelled cars. Surprise has been expressed locally that such cars will have to be built to order, but there is nothing surprising about it. There is no demand for petrol tramcars in Britain; the only places where they are used, we believe, and that on a small scale, are Morecambe and Bridge of Allan. Petrol tramcars may possibly do well financially where there is little traffic, but where the business is sufficient to warrant the capital expenditure for an electric tramway, the Corporation will be well advised to adopt the latter. The petrol car could of course run over the cable lines, but so could the electric car if equipped for the purpose. But if there is a burning desire to use petrol motors, why not mount them on omnibuses in the first place, and so test the routes for traffic before going to the expense of laying tramways?

IMPROVEMENTS IN GEARS AND PINIONS FOR TRAMWAYS.

By T. B. Goodyer.

An article entitled "Gears and Pinions" which appeared in the Tramway and Railway World in September, 1912, dealt mainly with the developments which were taking place in the manufacture of hardened gears and pinions.

The appearance of this article synchronised with the investigations that were being made on many tramways into the smaller, but none the less important, details of operation.

Gears and pinions were particularly under review because it was generally felt that gear life was being seriously diminished. This was probably not due to any falling off in material employed, but rather to the service of the modern tramway imposing severer conditions than had hitherto prevailed. Increase of speed, more rapid acceleration, quicker braking were calling for larger motors, and while these alterations were being made we were still using the same size of gear as that employed in the early systems.

These conditions obviously called for a higher grade of gear material than had been previously used. It meant greater strength at the root of the tooth, and if, with increased strength, a longer life could be obtained, it suggested a gain in efficiency as well as a reduction of noise.

Clearly, gears and pinions to meet these conditions would be expensive, particularly if they were of the treated variety, because, as is well known, a steel which will stand a hardening process must be necessarily of a very high grade, in addition to which the cost of treatment is considerable.

The initial cost of the gears and pinions is of considerable importance, but the cost of changing is an item which, though variable, must not be lost sight of.

It is now becoming possible to compare the high-grade gears with a prolonged life, with the short-lived, comparatively low-grade ones.

After careful and prolonged investigations, the following general laws appear to be fully established:

1. If the carbon contents of an untreated gear are less than ·30 per cent., it is disastrous to mate it with a hardened pinion.
2. If the carbon contents of an untreated gear are ·30 per cent. or over, the hardened pinion will not decrease its life; and, in cases where the carbon amounts to ·35 per cent. or more, the hardened pinion will prolong its life.
3. In either case the life of the hardened pinion will be considerably less than if mated with a hardened gear wheel.
4. Hardened gears and pinions, when mated together, give average mileages amounting to six or more times that of any other combination.

The Croydon Corporation were the first tramways in this country to use hardened gears and pinions. Previous to giving a trial, information was obtained from a number of street railway systems in the United States, and the results which had been secured, on the systems communicated with, clearly showed the necessity of effecting the change. The gears and pinions were of the now well-known tool steel manufacture, and the results obtained have been so satisfactory and convincing, that it has been decided to adopt them as the standard, and to replace all the untreated gears and pinions gradually.

The life of tool steel gears and pinions now in service on the Croydon system is almost in the nature of a revelation. Untreated gears and pinions have an average life of,

Gears, 250,000 miles;
Pinions, 45,000 ,, ;

whereas the results obtained from tool steel are as follows:

Gears. Car No.	Mileage.	Wear.	Miles per ·001 in. Wear.	Wear Expressed as Fraction of Total Permissible Wear.
49	81,607	·006	13,600	1/30
20	28,154	·002	14,072	1/90
Pinions.				
49	81,607	·012	6,800	1/15
20	28,154	·004	7,038	1/45

Perhaps one of the most attractive features of using hardened material is that, owing to the teeth maintaining their shape, noise is kept down to a minimum, and this is considered an important factor.

Although it has been possible by means of a micrometer gauge to measure the wear which has taken place at Croydon; the gear, after two years' hard service, is in excellent condition, the wear, of course, not being appreciable to the eye.

Similar results are being obtained on many tramways in the country, and it would certainly appear that soft gearing must shortly disappear entirely as, notwithstanding the higher initial cost of hardened gearing, their advantages are so important to tramway authorities, that it can only be a question of time before they are adopted as a standard practice.

Having regard to the extremely long life which can now be guaranteed, it would seem to be advisable to recast one's ideas on the split and solid gears. To facilitate the removal of a gear which was fairly quickly worn out meant one of the split type, but as we appear now with the treated material to be achieving a life which is equivalent to that of the axles, it would seem that there is every reason in favour of adopting solid gears, which in all respects must be much superior to split gears.

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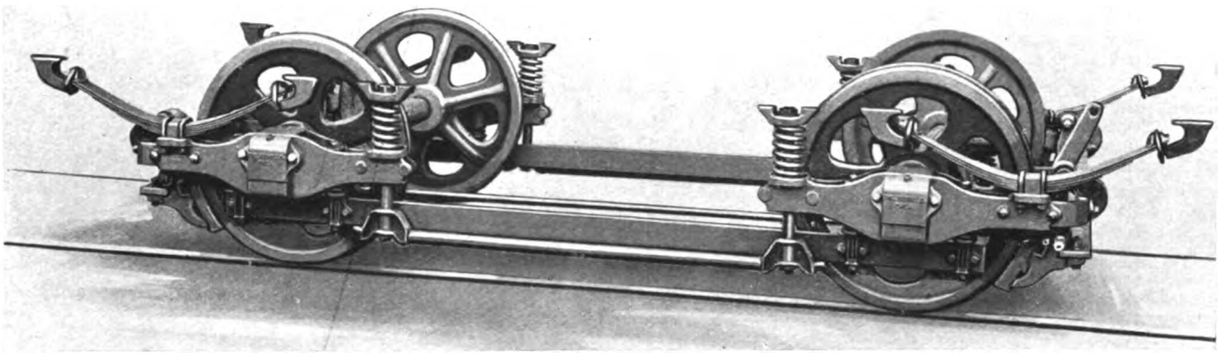
TRUCKS FOR TRAILER CARS.

The subject of the best design for trailer cars is one which is now occupying the attention of a good many tramway managers and engineers, because quite a number of tramway authorities in the country contemplate the use of trailer cars. Moreover, a good many of them do not mean to depend on getting the consent of the Board of Trade to run such cars, but are applying for specific Parliamentary powers for the purpose. The London County Council already have powers and intend to exercise them widely. The great advantages from the traffic point of view of trailer cars have frequently been pointed out in our pages, and indeed it may be claimed that our insistence upon the utility of these cars has done much in assisting to bring them again into use. Trailers of a kind were, of course, employed to some extent in the steam car days and also on a few lines in the earlier electric days, but their use appears to have been discouraged by the Board of Trade. That trouble is now being overcome, and there is a wide recognition of the usefulness of such cars in dealing with heavy traffic and in reducing street congestion.

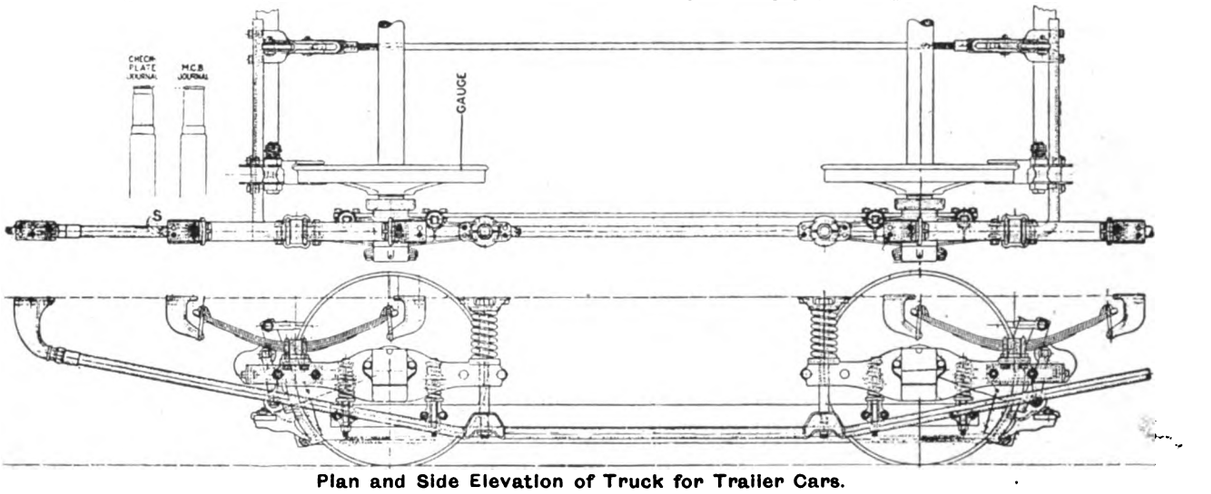


Truck for Trailer Cars.

In the design of a trailer car the truck is, of course, of much importance, as it must combine lightness with strength. We here give an illustration of the Brill No. 74 truck, which is in successful use under trailer cars in various parts of the world. It is a result of a careful development of the running gear type in order to provide for modern trailer car service. It is, of course, a vast improvement over the running gear in general use in the horse car and early electric car periods. The design incorporates an extremely light weight gear which at the same time possesses adequate strength and rigidity. The riding arrangement is easy, as the spring system is similar to that of the Brill 21E truck, but without the solid forged side frames. The main feature is the journal box, which is cast with extensions to support the body coil spring at one end and the semi-elliptic at the other. By casting a seat for the body coil spring at each end of the journal box and providing an additional casting to fit into this seat and to serve as a semi-elliptic spring seat, the journal box is made interchangeable. The long semi-elliptic spring prevents any tendency to galloping of the car body.

A channel steel crossing forms what, in a motor truck, would be called the end frame, and ties each pair of journal boxes together. Its principal purpose, however, is to serve as a support for the brake-rigging. The axles are maintained in a position parallel to each other by the spring posts, but with sufficient flexibility to suit the conditions of a running gear truck. The bar which extends under the journal boxes is attached to each journal by springs and bolts which pass through holes on each side of the journal box for the purpose of keeping the journal boxes in proper alignment.

A body truss pipe, arranged to be bracketed substantially to the car sill, is used on each side of the truck. The truss posts serve also as spring posts, as they pass through the body coil springs and are rigidly attached to the car sills by means of the body coil spring caps. The brake-rigging is arranged with a centre pull vertical lever, and includes the Brill half-ball brake hanger. The following are some dimensions of the truck for standard gauge track :—



Plan and Side Elevation of Truck for Trailer Cars.

	Ft.	In.		Ft.	In.
Centres of side frames ..	5	9½	Wheel base	7	6
Width over journal boxes	7	0	Total length	13	5½
Length of axle	6	5½	Spring base	12	5½

Height of truck (with 33 in. wheels) .. 2 ft. 2⅝ in.

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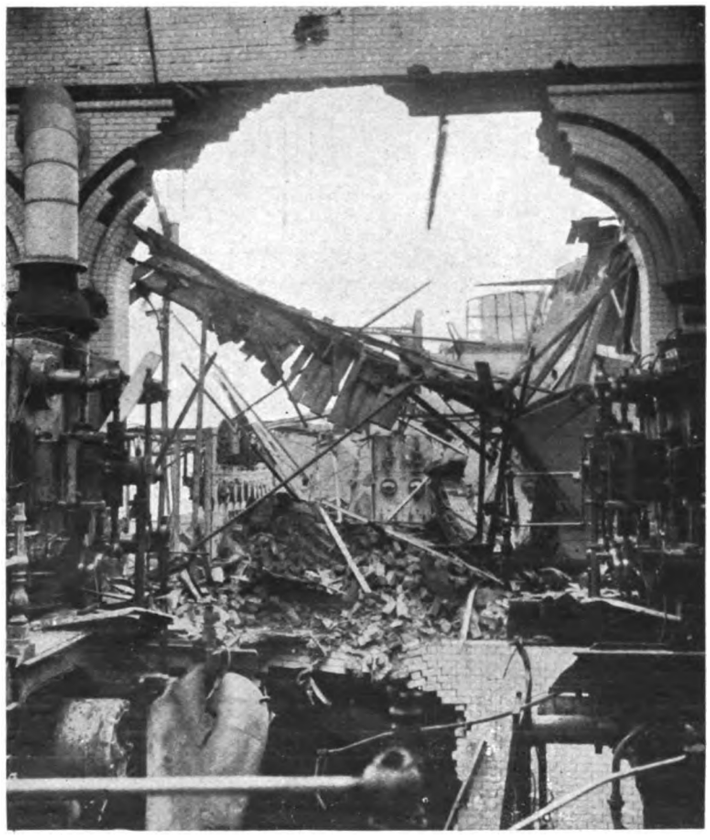
BURSTING OF A FLY-WHEEL IN CARDIFF TRACTION AND LIGHTING STATION.

An accident of a kind very unusual in this country occurred in Cardiff Corporation's power-station on March 21, when a 70-ton fly-wheel coupled to one of the engines burst and the flying fragments did great damage to the plant in the station and to the building. The loss is estimated at about £20,000. The station supplies electric energy both for the tramways and for part of the public lighting, and so serious were the results of the break-up of the wheel that both services were suspended. The tramcars began running to a certain extent two days later.

The following was the official statement issued on the evening of the accident by Sir John Courtis, chairman of the Tramways and Lighting Committee, and Mr. Arthur Ellis, the general manager: "The accident took place at 6-25 o'clock, and the cause of it is, so far, quite unascertainable. What has happened is that the engine carrying the load for the lighting service began to race, and the excessive speed of the fly-wheel consequent upon this resulted in the bursting of the wheel. Fragments of it, some of them weighing nearly a ton, were hurled through the roof and side of the building, causing considerable damage, and part of the switchboard was also damaged. It is very fortunate and providential that no one was hurt. It has been found impossible to resume the passenger service to-night, and on Monday the workmen's cars will not run in the early morning. It is, however, hoped that a restricted service will be commenced during the morning, and it is believed that the lighting arrangements will be fully resumed to-night. It is impossible yet to estimate the extent of the damage. Duplicate engines will be employed for the resumed restricted service."

When a careful examination came to be made the evidence of the disruptive force became still more apparent. A piece of the wheel weighing about a ton partially wrecked a brick-kiln some 300 yards away. The roof of the engine-house and one of the walls were partly shattered. The water circulating pipes were broken, and a fire-engine had to be got to pump the escaping water out of the basement. The electric generator to which the engine was coupled was badly smashed. A piece of the wheel over half-a-ton in weight which went through the engine-room roof fell through the roof of the boiler-room and crashed into the only boiler in the place which was not under steam.

View of Engine Room after the Accident at Cardiff Station.



The Engine Room showing Wrecked Roof and Walls.

At an emergency meeting of the Tramways and Lighting Committee held on March 22, Sir John Courtis said that the re-starting of the car service would depend on the progress made in re-placing the water pipes, and it was necessary that Mr. Ellis and Mr. Harpur should have instructions without delay. The work of removal of the debris and of putting the place into condition for re-construction was such that no contractor could be expected to tender a price for it, and the City Engineer had made the suggestion that the work should be given to the firm that had the best plant and the men for carrying out what was necessary expeditiously on percentage terms to be agreed upon above the actual cost.

At the same meeting Mr. Arthur Ellis (the manager and engineer of the department) said the most urgent need of the moment was to give temporary cover to the machinery, which was now exposed to the weather. The position was that one of the large engines had been entirely wrecked, and in his opinion it would not pay the committee to re-erect or re-construct it, because they would probably get a turbine at considerably less cost than they would have to pay for the re-erection of the wrecked engine. He had never heard or known of anything of the kind happening in any electric power station in the country before. He had no doubt in his mind that the engine accelerated to enormous speed, and the flywheel, of a dead weight of over 70 tons, with an electric generator of about the same weight coupled to it, burst and simply shattered the end wall and demolished most of the roof. It also damaged the engine immediately opposite to it, but the damage to that was not so extensive. The greatest difficulty had been with the large 20-in. water pipes serving the new machinery. These had been broken, and the water rushing down the centre of the engine-room, together with the force of the bursting of the flywheel, had affected the foundations of the engine very seriously. Large masses of concrete had been loosened and broken up. Mr. Peters, the deputy waterworks engineer, was soon on the spot, and, fortunately, it was found that the waterworks department had new pipes in stock, with the result that a sufficient number of them were hauled from Cogan before 2 o'clock in the morning. He was hoping that the concrete would

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have been removed in order to put the new pipes in, but there were many tons of solid concrete to be dealt with, and the task had been greater than anticipated. It was possible that it would be all removed by that evening, after which the new circulating pipes would be put in and the new plant in the power station could then be put in commission. He was pleased to say that the new plant had not been affected in any way; it was absolutely free from damage. It was also fortunate that they had four of the old engines in the other engine-room uninjured, and those had been put to work satisfactorily. The large battery at the Hayes Station had kept going the lighting of the city, and most of the important public buildings had been kept served by it until the old engines were set going; but this was not accomplished until the Hayes battery had been almost exhausted. Whilst the accident itself was extraordinary, the escape from loss of life was more extraordinary still. One could see pieces of metal weighing as much as 30 cwts. all over the place. There were several interesting features in the affair, for huge pieces of metal had been hurled through the roof in the direction in which the flywheel was revolving, and had continued their circular course, with the result that they returned through the outer walls of the boiler-house and back again into the building. No one had even been injured, and the most that could be said in that direction was the man in charge of the engine-room was naturally suffering from nervous breakdown. The switchboard boy, who was on the gallery at the time of the accident, was missed for some time, and his absence was a cause of considerable anxiety, but he turned up at last and said he had been to the telephone box. The cause of the accident was now quite unascertainable, and he did not think they would ever know the reason for it. He also did not think that anyone was to blame in the matter.

The Committee appointed a sub-committee to confer with Mr. Ellis and Mr. Harpur and to carry out expeditiously all that was necessary. The chairman paid a tribute to Mr. Ellis and his staff. Mr. Ellis mentioned that when the engine-driver saw the engine accelerating at an ungovernable rate he warned everyone in the building to get clear.

HALFPENNY FARES ON ILFORD TRAMWAYS.*

By L. E. Harvey.
(Tramways Manager and Engineer).

According to your instructions I have to report upon the question of abolishing the ½d. fares upon your tramways and establishing therefor a scheme of 1d. universal fares. I wish to make my position as manager of your tramways undertaking quite clear. I have assumed that you wish to make it pay its way and not to be a burden upon the rates, and I have also assumed that my duty is to advise you as to the policy that should be adopted to attain that end. I believe that I can and have done much to reduce the working expenses, but as regards the receipts I have been bound by the policy which you have seen fit to adopt. If my assumptions are wrong, and you consider that the public should be given travelling facilities at under cost price, and that the difference should be a charge upon the rates, then I have only to say that the responsiblity does not rest with me, but that I have done my duty in putting you in possession of my views upon the matter.

In the first place I must remind you that I presented, at your December meeting, my annual report for the year ending March 31, 1914, and that the loss shown on that year's working was £3,567, in spite of 1d. rate in aid during the year, and that the reserve fund had dropped from £5,611 to £2,294. At the time of writing this report our increased receipts for the current year are just over £5,000 up, and it is probable that by March next they may have increased to £6,500, due to the lease of the Barking section of line and to the reduced service and competition of the 'buses.

Our increased expenditure due to the extra running and to the Barking rent will be somewhere about £3,000, and that due to the wages of men serving the King will be about £550 for the eight months of the current year (at the rate of £800 per year), and that due to extra work on the track due to the paving of the breastwork in the High Road and Ilford Lane will be about £500 for the current year and a considerable amount for the following year, making a total of £4,050 extra cost this year.

Our increased gross profit for the year, other things being equal, will therefore approximately be £2,450, but, with other small economies, this may amount to £2,500, although it is very difficult to estimate exactly. If these figures are correct, and I believe them to be so, it will be seen that there will still be a loss on the net result for the current year.

It must also not be forgotten that we have had a demand from our employees for a large increase in their rates of pay, which demand has only been withdrawn for the time being, nor must it be forgotten that at the cessation of the war the 'bus company will resume its activities in this district, and I would also remind you that the cost of nearly all material has gone up, and that there will be an undoubted rise in our contract prices for next year.

Our reserve fund, as I have said, stands at the appallingly low figure of £2,294, and this after about 11 years' working, and it is, in my opinion, totally inadequate for future requirements. Our loans are equated for a period of 30 years, and it cannot be expected that our rails, even without the London County Council heavy cars inter-running upon them, will last this time, and many of them, especially the curves, points and crossings, will have to be renewed long before our loans are up. Moreover, in the near future we shall have to face a considerable expenditure in renewing the wood paving in the high road, which is getting very bad. You will thus see that it is imperative that we have ample funds in our reserve to draw upon; otherwise when these renewals come along there will be the only alternative to raise a rate in aid of the work.

My opinion is, and it is shared by all the men in the tramway profession throughout the country, that a tramway concern, being a commercial undertaking, should be run on sound commercial principles, and such as would be observed by any private trader, and it is obvious, therefore, that our goods should not be sold at under cost price, or, in other words, every passenger who patronises our cars should pay us at least the cost of his conveyance. Now, our total costs per passenger for last year work out at ·894 pence, and our total receipts per passenger at ·758 pence. It is clear, therefore, that we lose ·136 pence on every passenger carried, and since the ½d. passengers are more than ⅝ths of the whole number it follows that they are responsible for the greater part of the loss.

The following figures show the loss in another way, the average distance for ½d. fare being 1,375 yards:—

Total costs per car mile	8·497 pence.
Passengers per car mile	9·700
Costs per passenger per mile	·877 pence.
Costs per passenger per 1,375 yards ..	·688 ,,
Receipts per passenger per car mile ..	·781 ,,
Receipts per passenger per 1,375 yards ..	·610 ,,
Loss per passenger per ½d. stage	·078 ,,

And this loss would certainly have been greater had there been no 1d. or higher fares, the slight profit made on these fares making up some of the loss on the ½d. fares.

One must be guided very largely in questions of this sort by the experience of other towns, although of course local conditions must be considered, and if such places as Liverpool and Manchester, etc., have not thought fit to adopt ½d. fares, then it is natural to assume that they anticipate that their adoption would seriously jeopardise their financial stability. Belfast's experience of three weeks on ½d. fares should particularly be noticed; they hurriedly reverted to their old fares after losing £1,600 in that short period.

From the replies I have received from 80 tramway managers in this country which are given at the end of this report, there is a practical unanimity that ½d. fares are ruinous to any tramway undertaking, and even in those few towns where ½d. fares are favoured, there are special geographical reasons for it, and also in hardly any case is the distance given for a ½d. more than 880 yards as compared with our average of 1,375 yards.

The manager of the Glasgow system in his report of 1907, says: "Practically the whole of the fare received from the ½d. passengers is expended in fixed charges, and such passenger contributes nothing towards the actual cost of running the cars.

"It is a fallacy to suppose that the working classes are largely benefitted by the ½d. fares, but it is the business and shopping people, and it does not seem justifiable to carry this class of people under cost price."

The manager of Blackpool tramways says: "I think it is plain that your fares require revising if your Council are to make both ends meet. At the present time ratepayers are being asked to subsidise the travelling public in their riding facilities, which is not equitable."

And here I would remark, this view is particularly apt in the case of the ratepayers of the Cranbrook Ward, for here there is a very large population of highly rated residents who have no travelling facilities to the station, to and from which place the majority of them have to journey every day, and yet because the Council rules that people who have such facilities shall travel at under cost price, these residents have to make a payment through their rates to enable it to be done.

The manager of the Croydon tramways says: "For a system of 11 miles giving 1,375 yards for a ½d. fare with only eight million passengers, no other result but financial failure could be looked for. . . . . My opinion on the question of fare charges is that they should represent the commodity which the authority has for sale, and the sales of that commodity should not only include the ability of that authority properly to perform its functions of service, viz., the required charge for interest and sinking fund, but should also include due

* A Report presented to the Tramways Committee of Ilford.

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proportionate provision for the necessary renewals. . . . . I am quite sure that the discontinuance of the ½d. fares on the Ilford system would undoubtedly result in materially improving its financial position."

The manager of the Dundee tramways says: "Looking at your accounts it is perfectly evident that your earnings per car mile are too low for tramways. I have no hesitation in saying that you cannot afford to carry passengers over three-quarters of a mile for ½d."

The manager of the Glasgow tramways says: "It is quite absurd to imagine that with such a large percentage of ½d. fares as you have and to be only able to carry an average of 9·7 passengers, you can ever hope to meet expenses. . . . . I think the case of Ilford illustrates very clearly that it is quite impossible, on a small system, to rely as much as you do on ½d. fares. . . . . There is no doubt that it is about time you made some change in order to increase your revenue. Your expenditure appears to be very reasonable."

A number of other managers express similar opinions, and amongst them the manager of the Liverpool tramways emphatically says: "I quite agree with your views on the matter, that there is no likelihood of your undertaking ever being financially sound so long as ½d. fares are in existence."

As I have said, there is a concensus of opinion from these eminent men of the tramway world that ½d. fares are absolutely unsound for small systems, and we must assume that they have carefully studied the question and that their opinions are the result of mature consideration. It is therefore reasonable to deduce from these opinions and from the figures I have given that the ½d. fares are the cause of our bad financial condition. Such being the case, it behoves us to see whether a change for the better can be made, and I offered you the advice, carefully considered and recognising my responsibility in the matter, that you should abandon the ½d. fare and substitute therefor a system of 1d. fares only.

I am well aware that this is a drastic course, but serious maladies require drastic remedies. It is to be expected that a certain section of the public will abstain from riding on the cars at first, not because they cannot afford the increased fare, but from a feeling of resentment, and in addition the experiment will have been adversely criticised long before the actual results and figures can enable us to form a sound judgment upon the matter. Tramway business, perhaps, more than any other, depends for its success on the good feeling with the general public, and adverse criticism and recriminatory discussion will certainly for a time affect the receipts, but it is reasonable to suppose that after this has died down a large percentage of passengers who at first boycott the trams will bow to the inevitable and return to them, and this is amply borne out by the experience in other towns where a rise of fare has been made, such as Leith, Newport, Stalybridge, etc., as shown in the reports in the appendix.

Another point to be noted is that if ½d. fares are abolished and 1d. ones substituted, that the work of the conductors and the ticket staff will be much simplified, and the former will have more time to collect fares and to pay attention to their platforms and passengers, and to look out for intending travellers and prevent accidents in boarding and leaving moving cars.

I fully recognise that the question of abolishing the half-penny fares depends upon the line of policy our competitors, the 'Bus Company, are likely to adopt, but to my mind the only reason they are running their present half-penny fares is because we compel them to do so. Undoubtedly it does not pay them any more than it does us. So far as I know, they have never pretended to carry the public for any other purpose than to make profits for their shareholders, and it is to the interests of both of us that we adopt similar fare stages.

Were we to alter our fares I believe they would be only too quick to do the same. It must be recognised that the 'buses are here to stay, and that we shall always be in competition with them for the patronage of the travelling public. If, however, the Committee think it would be rather a bold step to take, and would prefer that I should first approach the 'Bus Company with a view to a working arrangement, I will do so, but, as I have said above, I do not think this is absolutely necessary.

1d. "Universal" Fare.

You will remember that in my original report in July, 1913. I suggested that 1d. universal fare should be charged in any direction from the Clock Tower in the Broadway, but I have given careful consideration to the objections and suggestions made at that time to that scheme, and to meet them I now suggest that two additional 1d. stages be made, viz., between Seven Kings Station and Barking Station, and between the Bell Inn and Barking terminus, the latter being effected by a transfer ticket available for changing cars at the Broadway and continuance of the journey by the next following car.

This will meet the objection that under my original scheme a passenger wishing to travel from, say, Christchurch Road to Grange Road, or, say, from Connaught Road to Khartoum Road, would have had to pay 2d. instead of the present two ½d. fares. . . .

The distances given for the 1d. fares will then be as follows:—

Broadway—Chadwell	4,860 yds.	= 2·76 miles.
Broadway—Barking Terminus	3,045 ,,	= 1·73 ,,
Broadway—Barkingside	4,550 ,,	= 2·58 ,,
Barking Station—Seven Kings Station ..	4,791 ,,	= 2·72 ,,
Barking Terminus—Bell Inn	4,305 ,,	= 2·45 ,,

I have always held the opinion that once a passenger has boarded the car and paid a 1d. fare, that it does not much matter, within reason, how far he is carried for that sum. The cost of his conveyance for 1 or 2 extra miles is extremely small provided his original fare pays for the cost of standing charges plus a margin for working costs, and this principle has been proved up to the hilt on the South Shields tramways, where the manager says, "It is nearly two years since we adopted a universal 1d. fare, with a most successful result; although it is possible to ride nearly 3½ miles for a 1d., we have experienced both an increase in the number of passengers and a substantial increase in the receipts."

Hull's tramways manager also says, "We had a 1d. universal fare up to seven years ago, and it founded the concern on a most secure and firm basis. I trust your Council will take the bull by the horns, act upon your suggestion, and endeavour to retrieve the position." A number of other managers also say that, from consideration of the data I have given them, that a universal 1d. fare must be the best thing for the Ilford system.

I will now consider the question as to the probable effect of the change upon our takings, and in arriving at my figures I will not go upon the passengers carried during the last financial year, although they would be more favourable, but I will base them upon the results since June 1st last, when the Barking lease commenced. Since this date, of course, the proportion of 1d. passengers to the whole number carried has increased considerably.

Passengers carried in 32 weeks of this financial year since Barking lease commenced, viz., June 1, 1914—Jan. 10, 1915:—

½d.	2,961,431	2½d.	21,304
1d.	2,106,239	1d. W.	186,170
1½d.	377,835	2d. W.	26,900
2d.	75,123	3d. W.	1,908
			5,756,910

Receipts: £19,173 3s. 3½d.

From these figures the average for 52 weeks is:—

½d.	4,812,325	*2½d.	34,719
*1d.	3,422,638	*1d. W.	302,526
*1½d.	613,982	*2d. W.	43,712 × 2 = 87,424
*2d.	122,069	*3d. W.	3,100 × 2 = 6,200

Receipts: £31,166 9s. 11d.

*Under the scheme these would be 1d. fares, totalling 4,589,558.

We have therefore a period of 32 weeks to go upon which is a very fair proportion of the year, and we can derive fairly accurately the probable number of each fare for the whole year.

Our receipts give £31,166 9s. 11d., or 7,477,548 pence.

It is therefore clear that we should require:—

7,477,548—4,589,558 = 2,887,990 ½d. passengers to consent to pay 1d. in order that our receipts still remain the same, or, in other words, we could afford to lose 1,924,335 ½d. passengers and still take the same money. I do not think it unreasonable to assume that we should *not* lose nearly two million passengers through the change, and not only this, but we should certainly have an increase from the present passengers using the 1½d., 2d. and 2½d. stages; there will be more patrons for these stages when they are reduced to 1d.

There is one ½d. stage, however, which we shall be bound to retain, and that is the stage in the Barking area from the terminus to Loxford Bridge. Although there is no express mention of it in our agreement, still throughout the negotiations between myself and the Barking manager it was tacitly assumed that there would be no alteration in the fare stages in Barking itself, and in my opinion we should certainly respect this arrangement. I would also advise that half fares be issued to all children between 3 and 12 years of age.

With regard to workmen's fares, our Act of Parliament, Section 30, says that the rates of charges for artisans, mechanics and daily labourers shall not exceed ½d. per mile (the lessees nevertheless not being required to take any less fare than 1d.), and Section 27 says that any fraction of a mile beyond an integral number of miles shall be deemed a mile. We should therefore be quite justified in not giving any further facilities to workpeople than the 1d. stages above enumerated.

After careful consideration, however, I advise that 1d. return tickets be issued to workmen for any 1d. stage on any car leaving the terminus up to 7 a.m., and to workwomen on any car leaving a terminus up to 8 a.m., Barking, Chadwell and Goodmayes being the termini of the High Road route, and the Broadway, The Horns, and Barkingside being the termini on the Ley Street route.

The return halves to be available for return journey on day of issue only.

In conclusion, I would say that I am confident every member of the Tramways Committee will give this matter his most careful attention and thought, but that some will still remain doubtful as to

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whether my arguments are sufficiently sound to induce them to make such a radical change in face of opposition for the time being from the travelling public. To those I would say that although I am personally satisfied that the scheme will be a success I realise their possible hesitancy upon the matter, and I suggest that they should give the scheme a trial for one year from April 1st next, and if it does not prove to be the success I confidently anticipate, then the old fares can be reverted to, but if on the contrary it is found that the takings have not suffered, and that the public have recognised that they must pay at least cost price for the ride they take, then the scheme can continue.

I append the opinions of 80 tramway managers upon the question of ½d. fares in general and on their effect on the Ilford system in particular, and I am sure that it will be your wish, whatever the outcome may be, that I should here express your sincere thanks for and appreciation of the valuable time and careful thought they have given to the replies to my queries.

P.A.Y.E. CARS IN ABERDEEN.

TRAMWAYS COMMITTEE CAPITULATE TO ORGANISED OPPOSITION.

The Town Council of Aberdeen held a special meeting on March 15, to consider the report of the Tramways Committee on the question of retaining or abolishing the P.A.Y.E. system on their cars. The Tramways Committee submitted the following resolution:—

"With reference to the minute of Council of date 1st inst., the committee have again had under consideration the question of the continuance of the P.A.Y.E. system of collecting fares on the Corporation cars. Having regard to the nature and extent of the opposition to the system on the routes where it has been in operation, the committee are of opinion that it is not expedient to continue any longer the P.A.Y.E. system of collecting fares, and accordingly resolve to recommend that it be now discontinued."

Bailie Robertson moved the adoption of the Tramways Committee's report. He could not say he was doing it with very great pleasure. He had always maintained that the pay-as-you-enter system had never had a fair chance. (Hear, hear.) The majority of the committee were of the same opinion. At the same time the cars were there for the people's use, and when the public objected, that ended the matter. The Tramways Committee had been of the opinion that there should be no change until the month of August. The matter had been before the Town Council on three occasions already, and had always been sent back. He did not see any use in wasting the time of the Council in discussing the matter further.

Councillor Reith seconded. It was perhaps a little humbling for the committee to come with that recommendation, but the cars belonged to the people, and as ex-Baillie Robertson had well said, they had a perfect right to say whether it should be the P.A.Y.E. system or any other. An amendment was proposed and seconded, but the motion was carried by 19 votes to 12. It is to be noted, however, that a number of those who voted for the resolution are in favour of the P.A.Y.E. system, but agreed that it should be abandoned meanwhile in deference to what appeared to be the will of the ratepayers and the users of the cars.

LONDON'S DEBT.

TRAMWAY INVESTMENT OF NEARLY TEN MILLIONS.

The aggregate net debt of London secured on the rates on March 31, 1914, was £108,606,825. During the year 1913-14 the fresh debt created amounted to £2,443,560. A large portion of the increase was incurred for revenue-producing services. The total net debt on March 31, 1914, was equivalent to 246·35 per cent. of the rateable value of London. The net debt attributable to revenue-producing undertakings was stated by the Finance Committee, in a report to the Council dated March 10, to amount to over 50 per cent. of the total, and is as follows;—

SERVICE.	MARCH 31, 1914.	MARCH 31, 1913.	Inc. or Dec.
Water supply (Metropolitan Water Board)—London's rateable proportion	39,455,767	39,454,765	+ 1,002
Tramways (London County Council) ..	9,923,529	9,882,881	+ 40,648
Electricity Undertakings (Metropolitan Borough Councils)	5,563,277	5,450,463	+ 112,814
Working-class dwellings (London County Council & Metropolitan Borough Councils)	3,486,664	3,464,845	+ 21,819
Miscellaneous	46,693	47,750	— 1,057
	58,475,930	58,300,704	175,226

The revenue of each of the undertakings mentioned above constitutes a primary security for the loans raised therefor, and the liability of the ratepayer for debt charges is only a contingent one. So long as the revenue is sufficient to meet the expenditure, including the charges for interest and repayment of capital, no charge will fall on the ratepayer.

BRISTOL TRAMWAYS EXTENSION SCHEMES.

AN INTERESTING SITUATION.

The Bristol Tramways and Carriage Company, as previously reported in these pages, are promoting a bill in Parliament to extend the time within which the company may construct certain lines of tramways authorised in 1904. The new lines are of a total length of over seven miles, and extend both within and without Bristol City boundary. In their note on the subject to the Town Council, the Parliamentary Bills Committee, after giving the details of the proposed new lines, report as follows:—"Though the lines are largely outside the City boundary, it must be remembered that by the Bristol Corporation Tramways Act, 1914, the Corporation are required, if they decide to purchase any tramways, to take the whole of the company's tramways, whether inside or outside the city, and therefore the Corporation now have an interest as potential purchasers in any tramways constructed outside the city which they did not formerly possess. With regard to the tramways to be constructed within the city, your committee consider that if the powers now asked for are granted the Corporation should have an opportunity of showing that the nature of the traffic using the roads to-day, as compared with the traffic conditions prevailing when the tramways were authorised, in 1904, renders it necessary for the Corporation to obtain further protection; and with regard to the tramways to be constructed outside the city, the present occasion is the first opportunity afforded the Corporation of criticising the conditions under which those tramways are to be constructed. Your committee are also of opinion that, inasmuch as the option of the Corporation to purchase the company's tramway undertaking arises on May 1 next, and may be exercised at any time within six months thereafter, the company ought not to enter into any agreements for laying down new tramways before the date when the option of purchase expires. Your committee have asked the Tramways Company to give an undertaking to this effect, but as the company did not see their way clear to comply with the request, your committee considered it advisable to lodge a petition in Parliament against the Bill, with the object of preserving the right of the Corporation to be heard in Parliament upon the foregoing matters, and your committee now ask that they be authorised to take all such steps as may appear to them necessary for safeguarding the interests of the Corporation."

YORKSHIRE TRAMWAY MANAGERS' ASSOCIATION.

A meeting of the Yorkshire Tramway Managers' Association was held at the Leeds Tramway Offices on March 11. Mr. J. B. Hamilton was in the chair, and amongst others present were:—

Messrs. A. R. Fearnley (Sheffield), W. J. McCombe (Hull), H. L. White (Grimsby), E. A. Paris and E. Parkinson (Heavy Woollen District), W. E. Nicholl (Scarborough), J. D. Caird and J. Galloway (Halifax), P. Priestley (Mexborough), W. McGibbon (Ossett), H. England, hon. sec. (Wakefield).

This informal association, which comprises the tramway managers of Yorkshire, Lincolnshire, and North Derbyshire, was formed in the summer of 1905, so that it has been nearly ten years in existence. During that time much good work has been done, and the meetings have given pleasure and profit to those who have attended. It has, however, been found difficult latterly to arrange meetings in the spring and summer months, as many of those desirous of attending are then engaged in other directions, and as each tramway system has been visited in rotation, the distances to be travelled were often found very considerable, necessitating a full day's railway journey.

In the early days of tramways, before equipments and material were more or less standardised, there was always something to be learnt when visiting even the smallest of systems, but things are now changed, and in consequence the Yorkshire managers have decided to reorganise their association. In future only two meetings each year will be held, in the months of November and March, instead of four as hitherto, and with a view to holding the meetings at the most convenient railway centres, it has been decided they shall be held in the cities of Leeds, Sheffield and Bradford in rotation.

Among the numerous subjects discussed at the last meeting were questions of Car Lighting under the Defence of the Realm Act; Fuel Deliveries; Increased Cost of Materials Used on Tramways, etc.

Mr. W. E. Nicholl, of the Scarborough Tramways, who recently resigned his position to join the British Electric Federation, was heartily congratulated. A vote of thanks to the hon. secretary, Mr. Harry England, for his services during the past ten years concluded the meeting.

British Electrical Mutual Aid Fund. The Fourth "Record" of the operations of the British Electrical Federation Mutual Aid Fund has been issued from the Federation offices. Four more men have been reported "killed in action," which brings the total death roll up to thirteen. The fund has received contributions amounting to £5,619, and the grants made to the dependents of the men in the service, chiefly on the recommendations of the local committees, amount to £4,049.

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LIVERPOOL CORPORATION TRAMWAYS.

The annual report for the year 1914 by Mr. C. W. Mallins, general manager of Liverpool Corporation Tramways, has now been issued, and it shows that the undertaking during the year continued to be in a highly prosperous condition, though the net revenue was somewhat less than that for the year 1913.

The following shows the results in brief form:—

The Total Revenue for the year 1914 amounted to ..	£722,307
Operating Costs (including Rental of Leased Lines)	£473,678
Gross Profit	£248,629
The Gross Profit has been apportioned as follows:—	
Interest	£50,082
Sinking Fund and Repayment of Loans	£63,726
Reserve, Renewal and Depreciation Account ..	£34,821
Contribution in aid of the General Rate	£100,000

The net profit for the year amounted to £134,822, a decrease of £19,342 as compared with 1913. This decrease is due to:—(*a*) Increase in rates and taxes of £11,000; (*b*) increase in the wages account of about £10,000 (including the allowance to dependents of employees who have joined H.M. Forces); (*c*) the supplying of 1¾ millions of free passes—representing a value of £8,232—to members of H.M. Forces. Although the profit was decreased, the contribution in relief of the rates is the same as last year.

The following figures are interesting in connection with the financial position of the tramway undertaking since it came into the hands of the Corporation, viz.:—

The total sum set apart for Sinking Fund and Redemption of Debt up to December 31, 1914, amounted to	£1,177,949 7 2
Reserve, Renewal and Depreciation	£800,623 14 1
(A considerable portion of this amount has been expended on the erection of certain buildings and on the renewal of the permanent way).	
Contribution in Relief of Rates	£572,898 19 7

In addition, the sum paid by the tramways since 1897 in rates and taxes amounts to £401,383 os. 8d.

The number of passengers carried, miles run, and traffic receipts for the year 1914, compared with 1913, are as follows:—

	1914.	1913.	Increase.
Passengers ..	145,656,374	144,085,927	1,570,447 or 1·1 %
Receipts ..	£684,026	£677,881	£6,145 ,, 0·9 %
Mileage ..	13,657,888	13,442,605	215,283 ,, 1·6 %

There was thus an increase in the traffic receipts of £6,145, notwithstanding the fact that the country was under war conditions for nearly five months.

The average earnings per car mile amounted to 12·02d., as against 12·10d. for 1913. This decrease is due to the issuing of free passes to members of His Majesty's Forces.

The traffic receipts and number of passengers carried for the first seven months of the year are the highest recorded in connection with the Liverpool Tramways, but the outbreak of war had a serious effect upon the traffic receipts. However, by the careful adjustment of the service to traffic needs, the loss in this respect has been reduced to a minimum. The receipts from January 4 to August 1 showed a progressive increase equivalent to 4 per cent., and, had this continued for the whole of the year, the receipts would have been improved by some £21,000, notwithstanding the fact that last year their Majesties the King and Queen visited Liverpool, and that an Industrial Exhibition was held for six months.

About 850 of the staff have been mobilised or enlisted in H.M. Forces since the outbreak of war, and, under a resolution of the City Council of September 2, 1914, it was decided to pay the difference between the wages of employees and the army allowance, which amounts to about £540 per week, or, approximately, £28,000 per annum.

Following a resolution of the City Council on April 1, the Tramways Committee appointed a Sub-Committee to wait upon the Mersey Docks and Harbour Board, in order to ascertain what facilities the Board would be prepared to grant for the transport of merchandise by tramways from the Liverpool Docks to various Lancashire towns. The Sub-Committee waited upon the Mersey Docks and Harbour Board on July 1 last, but the Board consider that the transport of merchandise by electric tramcar is, at present, impracticable.

Six additional motor omnibuses of the latest type, viz., two Tilling-Stevens, two Brush-Daimler, and two Straker-Squire, were delivered and placed in service in April and May last, and the Committee are trying the different types for the purpose of ascertaining which is the most suitable for operation in Liverpool. Three routes of omnibuses are now being operated, viz., Woolton—Calderstones, Aigburth—Old Swan, Walton—Seaforth. The total number of passengers carried during 1914 was 1,025,270, and the receipts amounted to £7,206.

The trial automatic point controllers installed in 1913 having proved satisfactory, the Committee, on February 13, 1914, decided to gradually equip the whole of the service with these point controllers, and 62 points have now been so equipped, and nearly the whole of the point attendants have been transferred to the car depôts. The change-over has resulted in considerable economy and convenience in operation, and has been effected without displacing a single employee.

An increased speed limit was granted by the Board of Trade on most of the routes, and the services have been arranged accordingly, with advantage to the travelling public.

The Tramways Committee took over their own third party risk on May 15, 1908, at which period they were paying to an insurance company the sum of £11,580 per annum. Since the Committee took over the business the amount paid in claims amounts to £29,611, or an average of £4,555 per annum, thus showing a saving during this period of £45,659, of which amount £30,000 has been placed in a Special Compensation Fund.

During the year the general overhauling of the rolling stock has been vigorously proceeded with. 100 cars have been equipped with the new 40-H.P. electrical equipments and have been thoroughly overhauled in every respect. In addition to this, another 100 cars were thoroughly overhauled, making a total of 200 cars dealt with. A considerable number of cars have also been painted and varnished, and the work of bringing the rolling stock into good condition is being pushed forward as rapidly as possible under the war conditions of labour. 16 new cars were completed and added to stock during the year, and an additional 11 cars are in hand.

The following statement shows the proportion of passengers for the various stages, viz.:

Value of Ticket.	Number sold.	Percentage of Total.
1d.	127,709,346	87·678
2d.	16,067,834	11·031
3d.	1,519,113	1·043
4d.	223,580	·154
5d.	5,190	·004
6d.	131,311	·090
	145,656,374	

The number of cars arriving at and leaving the Pierhead on the different routes in the busy season is 6,946 per day, South Castle Street 1,211, Old Haymarket 764, and Lime Street 124, representing a total of 9,045 cars running in and out of the city per day.

During 1914, 25 persons, who had been knocked down or had fallen in front of tramcars, were pushed clear by the Liverpool plough lifeguard, without serious injury. In the same period 8 fatal accidents took place.

There were 2,370 members on the books of the Tramways Benefit Society on December 31, 1914, as compared with 2,248 the previous year, an increase of 122. The sum paid in sick allowance during 1914 amounted to £2,667 7s. 11d., which was granted for varying periods to 1,180 members, each receiving an average of £2 5s. 2½d. The number of separate claims was 4,350, an increase of 154 as compared with 1913. 42 death claims were paid, of which 30 were members and 12 members' wives, compared with 19 and 13 respectively during 1913. The total income for the year amounted to £4,839 13s. 3½d., and the expenditure, including £513 10s. transferred to Retirement Fund, to £4,645, leaving a balance of £194 13s. 3½d. The sum standing to the credit of the Society on December 31 amounted to £5,100, all of which is invested in Liverpool Corporation Bonds, bearing interest at 3½ per cent. The Retirement Fund which was inaugurated on July 1, 1908, by the transfer of £3,000 from the Benefit Society surplus funds, now amounts to upwards of £23,000.

The membership of the Social, Athletic and Thrift Society on December 31 stood at 2,007, an increase of 53 on 1913. The receipts on general account, together with the amounts brought forward from 1913, amounted to £2,897 18s. 11½d., and the payments to £2,236 14s. 2d. The branch receipts amounted to £1,930 6s. 3½d., and the payments to £1,853 os. 9½d., leaving a total cash balance of £738 10s. 3½d. The total sum granted by the Society to the Retirement Fund now amounts to £650. During the year a sum of £42 10s. was voted in compassionate allowances to members who had been incapacitated by sickness for a considerable period.

Analysis of the working expenses shows that they amounted to 8·238d. per car mile, compared with 7·977d. in 1913. Adding rent of leased lines, interest, and sinking fund payments, the total is 10·322d. per car mile against 10·015d. The car mile earnings were 12·02d., against 12·1d.

Tramway Wages in Germany.—Berlin tramwaymen work long hours for small pay. According to a Berlin newspaper, conductors are getting 3s. 6d. a day for ten to twelve hours' work. Owing to the difficulty of inducing men to work under those conditions, the tramway company cannot fill the vacancies caused by men being called into army service, and a number of lines have ceased running.

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METROPOLITAN DISTRICT RAILWAY.

Below will be found an abstract of the accounts of the Metropolitan District Railway for the past year, along with comparisons with the year 1913. The accounts are not in the complete form required by the Railway Accounts Act, as this railway like most others in the country has come under Government control since the war began, and accordingly certain accounts and returns are omitted under authority from the Board of Trade. The receipts for the year include an estimated and unspecified sum to be received from the Government. The London "tube" railways are not included under Government control nor guarantee, and hence their accounts are as full as usual. The chief matters which thus have to be omitted from the following abstract are details of working expenses, details of receipts, and number of passengers. In any event, however, the details of the accounts of the Metropolitan District Railway are more difficult to deal with in a clear analysis than those of the "tube" lines, as matters are complicated by the company running over lines jointly owned and jointly leased or worked, and the figures in most cases are not given separately. It will be seen, however, that the total net receipts are somewhat down, as expenses—partly no doubt owing to the war—have gone up by over £30,000. It is gratifying to note that the percentage of railway expenditure to railway receipts (excluding miscellaneous receipts) is only 50·6, which is a good showing for electric traction on somewhat complicated city and suburban routes. There is no electric power and lighting account, which is described as not applicable to the company. Presumably this is because the Chelsea power station supplies also the London Electric Railway, but the accounts of the company are similarly silent on the subject, so that we are without details of the working costs of the power station.

CAPITAL ACCOUNTS.

	1914.	1913.
	£	£
Capital created:—		
Shares and stock	10,109,166	10,109,166
Loans or debenture stock	3,586,374	3,586,374
Total	13,695,540	13,695,540
Capital created by some other company on which the company jointly or separately guarantees fixed dividends:—		
Loans or debenture stock	429,000	429,000
Capital issued:—		
Shares and stock	9,530,905	9,530,905
Nominal additions	576,508	576,508
Loans and debenture stock	3,520,411	3,520,411
Nominal additions	60,000	60,000
Total	13,687,824	13,687,824
Capital expended during year	117,400	100,621
Total capital expenditure to date	11,549,474	11,432,074
Capital receipts (including premiums and discounts)	11,381,720	11,381,720
Subscriptions to other companies	600,000	600,000
Capital expenditure per mile of single track owned and open (exclusive of sidings)	211,917	212,689
Estimate of further capital expenditure	70,000	153,550

REVENUE ACCOUNTS.

	1914.	1913.
	£	£
Gross railway receipts (including for 1914 estimated amount receivable under agreement with the Government)	817,456	789,662
Railway expenditure	413,970	383,132
Net railway receipts	403,486	406,530
Miscellaneous receipts (net)	115,735	116,542
Total net income	519,221	523,072
Net income, including balance forward	531,880	531,601
Deduct interest and other fixed charges	343,662	337,262
Balance	188,218	194,339
Appropriation to reserve for renewals	20,000	20,000
Dividends on guaranteed and preference stocks	154,330 (*a*)	161,680 (*b*)
Dividend on ordinary stock	Nil.	Nil.
Balance forward	13,888	12,659

(*a*) 4 per cent on guaranteed stock, 4½ per cent. on first preference stock, and 2 per cent. on second preference stock.

(*b*) 4 per cent. on guaranteed stock, 4½ per cent. on first preference stock, and 2½ per cent. on second preference stock.

STATISTICAL RETURNS.

	1914. Mls	1914. Chs.	1913. Mls.	1913. Chs.
Lines owned:—				
Length of route	25	42	25	34
Length reduced to single track	54	44	53	71
Sidings reduced to single track	12	20	11	71
Total single track including sidings	66	64	65	62
Lines leased or worked:—				
Length of route	2	11	2	11
Length reduced to single track	4	12	4	9
Sidings reduced to single track	0	13	0	15
Total single track including sidings	4	25	4	24
Length of route authorised but not open	0	45	1	13

	1914. Number.	1914. Carrying Capacity.	1913. Number.	1913. Carrying Capacity.
		Seats.		*Seats.*
Rolling Stock:				
Steam locomotives	2	—	2	—
Electric locomotives	6	—	6	—
Motor Cars	232	11,016	206	9,760
Trailer cars	222	10,656	218	10,464
Total	462	21,672	432	20,224

In addition to the above there are 64 railway service vehicles compared with 49 in 1913.

Train mileage (excluding empty trains run for traffic purposes), shunting miles, etc.	5,272,972
Ditto in 1913	5,278,361
Total train mileage of all kinds	5,424,435
Ditto in 1913	5,338,440

FINANCIAL REPORTS AND MEETINGS.

Brazilian Traction, Light, and Power Company.—Dividend of 1½ per cent. for the three months ending March 31 on the 6 per cent. preference shares.

Manila Electric Railroad.—The directors of the Manila Electric Railroad Company recommend a dividend for the quarter ending March 31 of 1½ per cent. on the ordinary shares.

Halley's Industrial Motors.—A final dividend at the rate of 30 per cent. on the old shares, making 20 per cent. for the year, and at the rate of 20 per cent. per annum on the new shares.

Deficit at Southampton.—The estimates of the Tramway Committee of Southampton Town Council show that, after contributing £5,143 to the borough funds, there is a deficit of £920.

Wolverhampton Rates Assisted.—The Town Council of Wolverhampton have resolved to transfer £2,215 from the profits of the Electrity Department, and £4,018 from the Tramways Committee's surplus, to the rates fund.

South Staffordshire Tramways Company, Ltd.—The accounts for 1914 show a disposable balance, including £603 brought forward, of £3,728. The directors recommend a dividend of 3½ per cent. on the preference shares, carrying forward £843.

Wemyss and District Tramway Company.—After adding £200 to the redemption fund and £1,250 to depreciation reserve, the profits for 1914 amounted to £4,859. A dividend of 7½ per cent. on the ordinary shares is proposed, carrying forward £1,580.

The Melbourne Tramway and Omnibus Company, Ltd.—The London Secretary has received cable advice from Melbourne of the declaration of a dividend of 6d. per share for the quarter ending March 31, and also a bonus of like amount making together 1s. per share payable on April 1.

Cammell Laird.—A final dividend of 5 per cent. is recommended on the ordinary shares, making 7½ per cent. for the year, while £100,000 is placed to reserve, and £25,937 is carried forward. A year ago a dividend of 2½ per cent. was paid, £50,000 was placed to reserve, and £37,000 was carried forward.

Brown Bayley's Steelworks.—The directors do not recommend a further dividend. The past year's distribution will be represented by the 5 per cent. (actual) paid on both classes of shares in July. The ordinary shares received 10 per cent. for 1913, 15 per cent. for 1912, and 12½ per cent. for each of the three preceding years.

Lucan Tramway Company.—The annual report of the Dublin and Lucan Electric Railway Company, presented to the meeting of shareholders, showed a gross income for the year of £7,357. After paying debenture interest and other charges, there remains a balance of £362, which is to be carried forward to next year's account.

Hastings and District Electric Trams.—In their report for the year ended December 31, 1914, the directors of the Hastings and District Electric Tramways Company recommend a dividend of 6 per cent. on the preference shares, the allocation of £1,000 to depreciation, £1,500 to reduction of suspense account, and £1,121 to be carried forward.

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Colchester Tramways Deficit. The report of the Tramways Committee read at the meeting of Colchester Town Council, held on March 3, stated that the tramway manager and the borough accountant estimated that the approximate deficit for the current financial year would amount to £650, as compared with £2,333 for the previous year.

Jarrow and District Electric Traction Company.—The annual meeting of shareholders was held in London on March 1. Mr. H. S. Day, the chairman, expressed the view that the improvement which allowed of a 3½ per cent. dividend, compared with a 2½, was satisfactory, and there was reason to believe it would be at least maintained. The report was adopted.

Loss on Ilkeston Tramways.—The Tramways Committee of Ilkeston reported to the Town Council, at the meeting held on March 2, that the loss on the tramway undertaking for the year was £2,600, equal to a rate of 7d. in the pound. Commenting on the fact, the Mayor stated that during the twelve years the tramways had been in existence the ratepayers had been required to pay a bill for £33,199.

Madras Electric Tramways. -The gross profit for the year 1914 was £21,521. After deducting interest, London office expenses, allowance for debenture sinking fund, and £7,000 transferred to depreciation and renewals fund, there remains a balance which, including £3,320 brought forward, amounts to £12,621. A dividend of 5 per cent. on the ordinary shares has been paid

Blackpool and Fleetwood Tramroad Company. In moving adoption of the report of this company at the meeting, details of which were given in a previous issue, Mr. J. Greenwood stated that 25 per cent. of the company's employees had joined the Army, and regretted to say that two had been killed in action. During the year, £3,200 had been spent in the purchase of four covered cars. They had also extended the car shed to take in 12 cars, at a cost of £2,500.

Brush Electrical Engineering Company. The directors' report of the Brush Electrical Company states that, after providing for general charges, maintenance of buildings and plant, and interest on debenture stocks, there remains a balance of £19,109. The directors recommend that £10,000 be placed to a reserve account for depreciation, that £2,044 be applied in payment of the further 4 per cent. to which the holders of 6 per cent. prior lien participating second debenture stock are entitled, and that the balance of £7,065 be carried forward.

Walsall Tramways. -The annual report of the Tramways Committee of Walsall Town Council shows that the traffic revenue of the undertaking was £33,311, and the total revenue £34,089. Working expenses were £21,821. After paying interest on capital, allowance for sinking fund and the cost of alterations, there remains a net profit of £3,478. From that amount there falls to be deducted £1,000 as contribution to the borough fund on account of 1914, leaving a net surplus of £2,478. During the year the tramways carried 6,752,727 passengers, at a cost of 7.276d. per car mile.

Bath Electric Tramways.—The annual report of the directors of the Bath Electric Tramways Company states that, after charging expenses of working for the year ended December 31, 1914, there remains a balance of £16,132, which, with the amount carried forward from previous year, makes up a total of £16,993. After deducting interest on debentures, loans, etc., instalment of sinking fund, and dividend on first preference shares, a balance is left of £5,224, which the directors recommend should be carried forward, and used chiefly in replacing the motor fleet, which has been largely depleted by the requisitions of the Government for war purposes.

Hadfields Ltd.—The net profits for 1914 were £139,301, and £50,469 was brought forward. A final dividend of 10 per cent. and a bonus of 7½ per cent. are recommended, making 22½ per cent. for the year, adding £26,000 to the reserve and renewal fund, and carrying forward £60,270. The net profits were £109,512 for 1913, and £116,298 for 1912, and 20 per cent. was distributed for each year, sums of £15,000 and £20,000 being reserved on the respective occasions. The surplus at the end of 1912 was £49,455. Net earnings were £79,417 for 1911, and £69,955 for 1910, and the dividends for each period amounted to 17½ per cent., sums of £46,757 and £33,280 remaining.

Bournemouth Corporation Tramways.—The Tramways Committee of Bournemouth Town Council submitted the estimates for the year to the monthly meeting of the Council held on March 3. The estimated revenue for the year is £102,750, and the expenditure, including working expenses and capital charges, amounts to £95,141, showing a net surplus of £7,609. Working expenses were £56,800, capital charges, including £1,684 for ten new cars and permanent way reconstruction, amounted to £34,941; allowances to employees on military service took £2,400. There are 150 employees with the colours, entailing an expense to the Tramways Committee of about £80 per week.

British Aluminium Company.—The accounts for the year 1914 show that the profit, together with interest on investments and revenue from Kinlochleven and Foyers estates and transfer fee, is £272,256. Addition of £16,690 brought forward makes a sum of £288,946 available for appropriation. Allocation has been made as follows: - Provision for income-tax, legal expenses, bad and doubtful debts, depreciation of investments, and proportion of profits payable to directors, £24,965; prior lien debenture service fund, £48,000; reserve for depreciations, £50,000; to reserve account, £50,000. After paying the preference dividend, the directors are able to recommend a dividend of 5 per cent. on the ordinary shares, leaving £24,751 to be carried forward. Reserve account will now stand at £180,000, and depreciation reserve account at £200,000.

Para Electric Railways.—The general meeting of the Para Electric Railways and Lighting Company was held in London, Mr. Follett Holt, chairman of the company, presiding. The chairman, in moving the adoption of the directors' report, pointed out that there was a reduction in gross receipts of £50,000. Against that loss they were able to set a reduction of £32,000 in expenses, without any sacrifice in the upkeep of the property or of efficiency in the service. The directors had decided to add £25,000 to the reserve funds, bringing up the total to £132,000. Adding the amount they proposed carrying forward, the company had a total accumulation of £152,000 In view of all circumstances, the directors had no hesitation in asking the shareholders to confirm the reduction from 10 per cent. to 6 per cent. in dividend on the ordinary shares.

W. T. Henley's Telegraph Works Company. The net profits for 1914 were £90,125, after providing for debenture interest, and £59,065 was brought forward. A final dividend on the ordinary shares of 10 per cent., less income tax, making 15 per cent. for the year, and also a bonus of 5s. per share, are recommended, adding £30,000 to the reserve funds, and leaving to be carried forward £69,419. The net profits for 1913 were £85,665, and the distribution was similar to that proposed for the past year, £20,284 being set aside. Mr. Sidney Gedge, presiding at the meeting in London on March 19, said that, apart from the war demand, the business had grown, the turnover during the past year having been the largest they had ever had. They were able to pay a dividend of 15 per cent. and a bonus of 5 per cent. The trading profits were £7,000 more than in the previous year, amounting to £119,245 They were carrying forward £10,000 more. Prospects for the current year were good. They had sufficient orders on the books at the present time to pay a dividend. The report was adopted.

South Metropolitan Electric Tramways and Lighting Company.—The total revenue for the year 1914 from all sources amounted to £65,323, compared with £63,135 for the preceding year After adding the balance brought forward and deducting all expenses chargeable to revenue, and after setting aside the sum of £3,000 to renewals fund, there remains a surplus of £16,721, which the directors recommend should be appropriated as follows:—To be placed to reserve, £4,500; to payment of a dividend at the rate of 6 per cent. per annum on the preference shares for the year to December 31, 1913, £10,174; to payment on account of preference dividend for the year 1914, at the rate of 1 per cent., £1,695; to be carried forward, £351. The gross receipts derived from the working of the tramways and light railways amounted to £45,265, being a decrease of £177 as compared with the previous year. The net receipts from the company's motor omnibuses amounted to £2,387. The gross receipts from the electricity supply section of the undertaking (including the amount represented by the sale of energy to the tramways) amounted to £16,441, as compared with £15,694 for 1913.

Stewarts and Lloyds.—The report for the year 1914 shows that after providing for debenture interest and adding £100,000 to the depreciation fund the net profit amounts to £233,420. The sum of £95,371 was brought forward from the previous year. It is proposed to pay a final dividend of 2s. per share on the deferred shares, making 2s. 6d. per share (12½ per cent.), free of income-tax, for the year, to add £50,000 to the reserve and £10,000 to the employees' benefit fund, and to carry forward £97,666. The net profits and the dividends on the deferred shares, after making additions to the depreciation fund, for the past five years, are shown in the table following:—

	Net Profits.	Added to reserves.	Dividends Per annum.	Carried forward.
1914	£233,420	£60,000	12½ per cent.	£97,666
1913	246,065	70,000	12½ ,, ,,	95,371
1912	266,896	47,817	10 ,, ,,	90,431
1911	202,133	70,000	5 ,, ,,	86,539
1910	162,647	32,156	5 ,, ,,	83,030

A year ago and in 1912 sums of £100,000 were added to the depreciation fund and £70,000 in each of preceding years.

London United Tramways.—The gross receipts of this company for the year ended December 31 amounted to £327,871. After adding the balance brought forward from 1913 and deducting all expenses chargeable to revenue, including £12,500 to reserve for reconstruction and renewals, there is a balance of £8,142. The directors recommend that a dividend on the preference shares of one-half per cent., requiring £6,250, be paid and the balance of £1,892 carried forward. The traffic receipts amounted to £316,838, showing a decrease of £11,768 as compared with the previous year. This decrease is due to the conditions which have prevailed since the outbreak of war in August last. Owing to the number of employees who, as reservists, were recalled to

(*Continued on page 281.*)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ...	*May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington ...	*Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne...	*Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1914	Sept., 1901	,,	9 30	...	...	...	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ...	*Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ...	*Mar. 25, 1914	Mar., 1899	,,	24 63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool ...	*Mar. 31, 1914	June, 1899	,,	(p) 21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	*Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford ...	*Mar. 31, 1914	July, 1898	,,	(h) 106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	*Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	*Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	*Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1914	June, 1903	,,	21 2 (b) 13 21	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l) 29,518	69,745	335	70,080
Chester	*Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ...	*Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ...	*Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	*Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington ...	*Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	*Mar. 31. 1914	July, 1904	E.	22 20	...	...	...	245,332	11,026	177,676	67,656	(l) 32,356	E 51,126	1,048	52,174
			H.		...	...	...		...	...	...	...	H 429	19	448
Doncaster ...	*Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham ...	*Mar. 31. 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	*Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ...	*Mar 31. 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	*Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	*Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	*Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	*Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley ...	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock ...	*May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ...	*May 15, 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster ...	*Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	*May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	*Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool ...	*Dec. 31, 1914	Nov., 1898	,,	124 0	...	...	...	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ...	*Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ...	*Mar. 31. 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ...	*Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	*Mar. 31. 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.).	*Mar. 31. 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ...	*Mar. 31, 1914	Jan., 1901	,,	...	...	...	...	667,705	...	410,091	237,501	68,372	172,731	2,648	175,379
Oldham	*Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth ...	*Mar. 31, 1914	Sept., 1899	,,	15 0	...	...	...	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ...	Mar. 31. 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall ...	*Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	*Mar. 31, 1914	May, 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham ...	*Mar. 31, 1914	Jan., 1903	,,	12 2	...	183,775	...	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	*Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ...	*Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31. 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ...	*Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ...	*Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l) 26,881	37,744	586	38,330
Staly'ge, H., M., D.	*Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport ...	*Mar. 31, 1914	Aug., 1901	,,	27 5	...	...	...	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	*Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey ...	*Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1913	Dec., 1902	,,	19 44	188,145	188,100	45	183,351	9,378	159,561	58,366	33,873	32,991	682	33,673
Walthamstow ...	*Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington ...	*Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham ...	*Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	*Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	*Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)...	*Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	*Mar. 31. 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1914	Nov., 1905	E.	98 54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	*Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead ...	*Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	*Mar. 31, 1914	July, 1902	,,	(e) 29 62	432,440	...	...	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	*Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry ...	*Mar. 31. 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1914	Oct., 1898	,,	193 40 (h) 2 53	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
Huddersfield ...	*Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	*Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	*Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester... ...	*Dec. 31. 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	*Mar. 31, 1914	...	H.	13 73	...	...	...	...	...	...	...	...	21,145	480	21,625
		May, 1903	C E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	*Mar. 31. 1914	Dec., 1901	,,	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ...	*Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth ...	*Mar. 31, 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	*Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	*Mar. 25, 1914	Sep., 1899	,,	79 3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	*Mar. 31. 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Additional lines leased and worked. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1¼ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 8 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit.					Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-und r-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	50,721	9,423	16,898	20,151	77,193	66,581	995	(h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	38,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906	5,499 81	8,610	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 684
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,432	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	...	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 681
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1, 310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	...	...	...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,291	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,019	3,201	4,678	5,710	21,608	12,065	1,371	5,191	3,439	458	1,868	...	10,956	+ 2,480
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,230
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(c) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	..	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,008
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10 806 E 809,987	3,679 (r) 183,797	4,059 345,138	m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(t) 18,079	784,349	− 88,526
N'castle on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	..	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses.
(n) Transferred to motor omnibus capital account (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account.
(r) Including special charges, £6,063. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit motor char-a-banc. (z) Includes £6,519 rent of leased lines. ; £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Per-centage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Costs).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	610,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421 844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,825	1·125	1·70
Blackburn ...	4,011	...	...	14·08	13·46	3·41	·97	2·93	2·06	9·37	66·10	7·37	1,901.668	1·3	1·64
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·53	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·201	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·38	10·26	2·315	·769	1·213	1·252	5·549	50·44	4·297	2,037,620	1	1·252
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378.158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·523	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·28
Darwen	448	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E 10·358	10·150	3·438	·577	1·092	1·709	6·816	65·8	5·107	1,425,112	1·45	1·179
				H. 6·077	5·821	7·325	...	1·099	...	8·424	138·6	...	...	...	...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	63·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·843
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	7,013	24,000	...	11·87	3·04	1·04	1·54	1·92	7·54	61·82	5·42	5,359,804	1·25	1·51
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·06	1·09
Plymouth ...	...	...	4,037	12·066	11·480	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ...	4,287	750	12·54	12·52	2·92	·87	2·22	2·79	8·80	70·15	6·01	1,731,184	1·375	2·03
	R.T....	1,009	...	10·74	10·74	2·44	·76	2·68	1·23	7·11	66·20	5·88	120,303	1·375	1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·820	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848.538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·385	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·849
Stockport ...	...	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	1,480	...	1,000	11·234	11·007	2·675	1·068	1·561	1·905	7·209	64	5·304	845 654	1·68	1·176
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1½	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·842
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21	8·94	3·32	·76	1·41	1·01	6·50	70·55	5·49	154,048,461	·601	2·63
				H. 8·15	7·97	4·07	1·39	1·53	4·40	11·39	139·72	11·39	...	...	...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30.581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Traffic Records. Car Mileage.	Passengers Carried.	Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		*d.*	*Miles.*	*d.*	*Miles.*			
Aberdeen	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10·5	·508	1·80	·58	7·5	703	54	77
Accrington	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11·1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,244	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn	200,000	1,149,462	12,731,532	11·07	1·28	63·15	105	2,751	6/10	·88	1·25	·76	7·5	448	32	61
Blackpool	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24/9	·73	..	...	8	...	34	78
Bolton	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/	·578	1·553	·633	7·25	1,030	73	112
Bradford	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6·3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10 10	·543	1·24	·85	8·51	483·83	45·26	54
Chester	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5 5	·78	1·38	·75	7·33	126	7	17
Colchester	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4·8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9/10	·871	2 05	·50	8·14	942·23	59	75
Darlington	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	..	...	...	...	...	...
Derby	124,000	E 1,208,880 H. 17,710	12,136,148 110,231	10·039 6·224	1·011 ·935	97·88	...	2,398 ...	8/3 ...	·67 1·35	1·44 1	·75 1	6·375 ..	... ...	... ..	50 3
Doncaster	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8·2	·547	2	·50	7·3	...	...	68
East Ham	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax	176,000	2,242,085	20,276,077	9·04	1·26	115	80·21	1,958	12/4	·867	1·30	·87	7·23	853·93	77	101
Ilford	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,236	5/7	·62	1·843	·69	8	...	..	26
Ilkeston	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52 8	·8	1·50	·5	7	101	7	13
Ipswich	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	185	17	22
Lancaster	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6/11	·532	1·75	·428	7	90	5	8
Liverpool	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	...	...	...	662
Nelson	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,543,669	40,535,874	11·43	1·02	155	92·72	...	13/2	·642	1·70	1	6·66	...	105	135
Oldham	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	..	...	6·25	120	8	12
Plymouth	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	..	42
Pontypridd	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10/9	·751	1·12	·88	9	247·5	15	24
Rochdale	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham	64,000 ...	E 852,639 RT 128,685	9,874,231 471,690	11·58 3·67	1·08 2·72	154·3 ...	... ...	3,701 ...	13,9 ...	76 1·92	... ...	... ...	... ...	... ...	... ...	... ...
Salford	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543 941	13,162,224	8·52	1·23	108	77·38	3,624	11/1	·82	1·25	·55	...	...	..	70
Southend	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·68	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6·9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport	120,000	1,490,116	...	...	...	...	...	2,356	11 2	...	..	...	...	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall	100,000	719,372	6,121,381	8·509	1·293	61	86	1,885	6/7	·847	1·24	·79	7	345	23	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·51	7·75	1,235	95	118
Wigan	200,300	1,500,846	14,235,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8·4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·28	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournemouth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17·5	·824	1·19	·87	6·8	1,140	60	81
Cardiff	182,729	2,966 230	31,122,962	10·49	1·09	170	98·5	4,447	15·6	·65	1·44	·736	7·5	1,264	79	130
Coventry	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds	525,000	9,204,331	93,679,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London	...	E 58,572,356 H 636.933	516,338,859 613,781	8·82 10·38	1·01 ·77	...	120·18 77·12	7,866 1.519	... ...	·73 1·09	... ...	... ...	9·05 5·85	17.728·8 203·14	1,335 23	1,722 56
Newcastle	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6 4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7.7	·764	1·01	·95	7·36	404·7	21·3	33
Reading	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16·1	·533	2·789	·379	...	3,372·5	232·587	335
Tyldesley	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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the colours, it was found necessary to reduce the services, and further reductions had subsequently to be made owing to the enlistment of employees in the new armies. The number of men at present serving with the Forces is no fewer than 381, equivalent to about 24 per cent. of the entire staff. During the year a considerable length of track has been reconstructed, and £29,439 has been charged to the reserve for reconstruction and renewals. The mileage open is 53·5, and the company now has 338 cars. The number of passengers carried was 61,433,783, and the car miles run were 8,996,891. The average receipts per car mile were 8·47d., a decrease of ·08d. Mr. W. M. Ackworth, presiding on March 26 at the meeting of this company, said in regard to the revenue account, after allowing for the appropriation to reserve for reconstruction and renewals there remained a balance of £8,142. The traffic receipts amounted to £316,838, a decrease of over £11,700. The car mileage run was some 410,000 miles less than in 1913. Up to the beginning of August the passenger receipts were £2,243 in excess of those of the corresponding period for 1913; but by the end of the year that increase had been turned into a decrease of £11,793. Apart from the reduced services, the receipts decreased owing to the earlier closing of publichouses, and the restricted street lighting.

London and Suburban Traction Company.—The ordinary general meeting was held on Friday, March 26. The Right Hon. Stuart Wortley, K.C., M.P., presided, and said that the total traffic receipts on the traction and omnibus companies in which they had interest during the last year were £1,303,912, against £1,152,494 in 1913. The passengers carried were 246,831,117 against 218,900,648 in 1913. With regard to the supplies of electric current, 39,510,388 units were sold, against 36,904,469 in 1913. The total income from their holdings in the subsidiary companies was £107,884, plus £10,593 for interest on money lent to those companies. These figures compared with £98,925 and £6,309 respectively for the year before. Including this payment to sinking fund, the total expenses amounted to £34,953 against £17,118 for 1913. The result was that they had been able to find £80,110 for full dividend at 5 per cent. on the preference shares, as well as £9,226 for a dividend on the ordinary shares for the first half only of the year at the rate of 1 per cent. per annum, finally carrying forward £2,886, against £8,597 in the previous year. In the first half of 1914 they had a fair prospect of realising the hopeful anticipation in which he indulged when he spoke last year. It was in the early days of July that their interim dividends were declared. The effect of the war on the company's business had undoubtedly been adverse, but it might very well have been worse. What would be the company's experience during the remainder of the war no one could say, but he thought that they were well justified in hoping that peace would bring a return to them of at least the modest prosperity that the first half of 1914 seemed to promise.

Metropolitan Electric Tramways, Limited.—The revenue for the year amounted to £531,587, and after adding the balance brought forward from 1913 and deducting all expenses chargeable to revenue, there remains an available balance of £47,604. The directors recommend that this sum shall be allocated as follows:—To reserve account, £12,000; preference shares dividend, £25,000; ordinary share dividend at 2 per cent., £9,486, leaving £1,118 to be carried forward. Traffic receipts amounted to £467,414, showing a decrease of £8,510 as compared with the previous year. This decrease is due to the conditions which have prevailed since the outbreak of war. Owing to the number of employees who, as reservists, were recalled to the colours, it was found necessary to reduce the services in August last. Further reductions had subsequently to be made, owing to the enlistment of employees in the new armies. At the present time 484 employees, equivalent to about 25 per cent. of the total staff, are serving in the army or navy. The business of the North Metropolitan Electric Power Supply Company, in spite of the decrease in a number of units supplied for traction purposes during the last five months of the year, has been satisfactorily maintained; the total number of units sold during 1914 amounted to 36,869,118, an increase of approximately 7 per cent. over the figures for the preceding year. The number of passengers carried was 93,325,170, and the car-mileage 11,479,592. The average receipts per car-mile amounted to 9·77d., an increase of ·46d. The company now has 312 cars, and the track-mileage remains as last year—viz., 56·25 miles.

Mr. O. W. Brain, M.I.E.E., chief electrical engineer for railways and tramways, N.S.W. Government, has accepted the position of president of the Electrical Association of Australia. Other officers are:—Vice-Presidents, W. H. Alabaster, chief assistant electrical engineer, Melbourne City Council; W. H. Myers, assistant engineer, Electrical Branch, N.S.W. Government Railways and Tramways (president of the New South Wales Section); members of Council:—Prof. Henry Payne (Melbourne University, engineering department), Mr. W. J. Newbiggin (director, Adams and Company, Melbourne), Mr. H. R. Forbes-Mackay (city electrical engineer, Sydney), Mr. A. C. F. Webb, M.I.E.E. (consulting electrical engineer, Sydney).—*Sydney Morning Herald.*

THE BRITISH WESTINGHOUSE COMPANY.

AN ENCOURAGING YEAR.

The 15th annual meeting of the British Westinghouse Electric and Manufacturing Company, Ltd., was held on March 29, at Hamilton House, London, E.C. Mr. J. Annan Bryce, M.P., chairman of the company, addressing the shareholders, said that the net profit had been about £45,000 more than in 1913, and that this excellent result was caused mainly by increased efficiency. The profit of the year was almost entirely derived from contracts entered into before the war, and they had already suffered, and were likely to suffer still more, from the war, though its injurious effects were not apparent in the accounts of 1914. If they had divided the profits right up to the hilt the amount would have allowed a distribution of 15 per cent. on the capital, but they proposed to continue the policy of strengthening their resources by building up reserves. They had accordingly added £50,000 to general reserve, written £25,000 off goodwill, and carried forward a rather larger sum than last year. The sudden outburst of war in the beginning of August disturbed their industry; but the stoppage of business with Germany began to make itself felt, and orders were received in replacement of cancelled German contracts. At the same time the War Office and Admiralty placed contracts with them. Owing to these causes the volume of orders finished up at December 31 was only 17 per cent. behind that of 1913. They considered the acquisition of their American friends' interests in the French and Italian Westinghouse Companies a good bargain.

The 15th annual report of the company covered the year ended December 31, 1914. The directors state that, notwithstanding the abnormal conditions arising out of the state of war, the accounts showed continued improvement. The net profit for the year amounted to £151,627, which compares with £106,493 in the previous year. Including the balance brought forward of £6,493, there was a total sum for appropriation of £158,121. The directors recommended that this should be dealt with as follows:—General reserve, £50,000; to be written of patents, goodwill, etc., £25,000; dividend on preference shares at 7½ per cent., £75,000; balance carried forward. £8,121. Substantial sums have again been charged against revenue for the maintenance of works and plant, and in addition the sum of £50,846 has been applied to depreciation. Since the end of the year the company has acquired from the American Westinghouse Company their interests in the French, and, through it, in the Italian Westinghouse Companies. Mr. Alex Spencer, a director of Messrs. George Spencer, Moulton & Co., and vice-chairman of the Metropolitan Carriage, Wagon and Finance Company, Ltd., has been elected a director.

NOTICES.

Messrs. Estler Brothers have temporarily closed their office at Dowgate Hill, E.C., and their sole office in London is now at South Molton Road, Victoria Docks, E.

Clough, Smith and Company, Limited, have taken new premises at Regent House, Kingsway, London, W.C., to which address all communications should be sent. Their telegraphic address is "Clufmit Westcent, London," and their telephone number "Gerrard 3288."

The Peckham Truck and Engineering Company, Limited, have removed their offices from Queen Anne's Chambers to St. James's Park Chambers, 32, Broadway, Westminster, S.W. Their telegraphic address is "Truxenpeck, London," and their telephone number "Victoria 6565."

The Tramways and Light Railways Association.—As at present arranged, the Annual Dinner of this Association will be held in June. The exact date will be announced later. Through a misunderstanding, it was stated in our issue of March 11 that the dinner had been postponed, but the Council hope that members will have the opportunity of meeting informally in June.

Proceedings of the Municipal Tramways Association.—The annual report of the Municipal Tramways Association has now been published, and copies can be obtained at the price 5s. each on application to the hon. secretary (Mr. C. J. Spencer), at 5 and 7, Hall Ings, Bradford. The report is of much interest, and contains, among other valuable matter, the papers read before the managers' section, together with an extensive digest and analysis of private Acts passed during sessions 1913-14, in respect of Railless Traction and Motor Omnibus Legislation, which will be found extremely useful for reference. Local authorities and others desirous of obtaining copies of this report are advised to make early application.

Paper Money Note Holder.—The Peacock Brake Company, 27, Clements' Lane, London, E.C., have sent to us a very ingenious and convenient folder for keeping £1 and 10s. notes in such a way that they are readily accessible and apart from the usual contents of a pocket book. Notes of each denomination have merely to be laid on the respective sides of the holder and they are then by a slight manipulation firmly secured. How this is done readers may be left to discover for themselves.

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CONTRACTS AND ORDERS.

The British Westinghouse Company have an order from Barrow Town Council for a 200-K V.A. transformer.

Leeds Tramways and Electricity Committee has accepted the tender of the British Westinghouse Company for switchgear.

The Davenport Engineering Company have an order for a new cooling tower for the Blackpool electricity works.

Blessington Steam Tramway Company, of Dublin, has ordered two petrol electric cars to be used during the season of summer traffic.

Prahan and Malvern Tramway Trust, Victoria, has placed an order with Noyes Pty., Limited, for a booster and switchgear at £920.

Dick, Kerr and Company, Limited, have an order from Dover Tramways Committee for the supply of 50 tons of rails and the necessary fishplates.

The Albion Motor Car Company, Limited, have received an order from the Burmah Railway Company for a 15-H.P. 15-cwts. Albion box van.

Darlington Town Council has accepted the tender of Messrs. Fraser and Chalmers, of Erith, for a 3,000-KW. turbine and Siemens alternator.

The Macintosh Cable Company, Limited, have been selected as contractors to Ayr Corporation for the supply of cables, amounting to £9,624.

Chamberlain and Hookham, Limited, have a contract for the supply of tramcar meters for one year to Manchester Corporation Tramways.

The United Electric Car Company's tender for vestibules, staircases, etc., for 18 cars has been accepted by the Wolverhampton Tramways Committee.

Jas. Smith and Company (Derby), Limited, have an order for uniforms from Aberdare Urban District Council Tramways and Electricity Department.

The Glasgow Numerical Ticket and Check Book Printing Company have an order for tramway tickets for Aberdare Urban District Council Tramways.

Maidstone Town Council has accepted the tender of the Brush Electrical Engineering Company for a 1,250-KW. turbo-alternator of the Ljungstrom type, at £6,887.

W. A. Stevens, Limited, of Maidstone, have an order from Walsall Corporation for four double-deck and two single-deck petrol-electric omnibuses at £5,545 16s.

The British Westinghouse Company, Limited, have arranged a contract with the Melbourne City Council for a 5,000 KW. turbo-alternator at £15,111, and spare parts, £1,015.

Shrewsbury and Challiner, Limited, have secured contracts for tires for the Metropolitan Asylums Board and for the motor omnibuses of the Manchester Corporation Tramways.

Manchester Tramways Committee has accepted the tender of the British Insulated and Helsby Cables, Limited, for the supply of rail bonds, and of Hadfields Limited, for steel portable track rails.

Siemens Brothers Dynamo Works, Limited, have received an acceptance of their tender for the supply of carbon and metal filament lamps from the Colchester Corporation Tramways for the ensuing 12 months.

Siemens Brothers Dynamo Works, Limited, have again secured the contract for the annual supply of Wotan, Tantalum and Carbon filament lamps to the Salford Corporation Tramways Department.

The British Thomson-Houston Company, Limited, have been selected by Dover Corporation as contractors for the supply of a 1,000-KW. turbo-alternator set complete with exciter, condenser, and pumps, at £4,725.

Babcock and Wilcox, Limited, are to supply a boiler, superheater and economiser at £4,215, two chain-grate stokers, a motor-driven induced-draught plant with iron chimney, and an indicating steam flow meter to Croydon Town Council.

The Titan Trackwork Company, Limited, of Sheffield, have received a large contract from the Melbourne, Brunswick and Coburg Tramways Trust for turnouts, crossovers, and car shed layout in their "Titan" manganese steel.

York Electricity and Tramways Committee has accepted the tender of the Brush Electrical and Engineering Company for six double-deck cars at a price of £507 10s. each; also the tender of the British Thomson-Houston Company, Limited, for the electrical equipment of these cars at £304 each.

Croydon Borough Council has accepted the tender of Callender's Cable and Construction Company, Limited, for the supply of electric cables for the year to March 31, 1916. This is subject to a clause providing for payment on a sliding scale based upon the price of copper, which was reported to be about £70 per ton.

West Ham Corporation have accepted the following tenders as follows:—Bodies and trucks for 15 new tramcars, Brush Electrical Engineering Company, Loughborough; electrical equipment for 15 new tramcars, British Thomson-Houston Company, Rugby; controllers for the same, British Westinghouse Electric and Manufacturing Company, Trafford Park.

E. Bennis and Company, Limited, have received a repeat order from Coventry Electricity Department for eight chain grate stokers, 7 ft. by 13 ft. 6 in. centres, for Babcock and Wilcox boilers. Messrs. Bennis have also a repeat order from Manchester Electricity Department for re-linking with Bennis patent chain grate links two pairs of chain grates of another type at the Bloom Street power station.

Port Elizabeth (S.A.) Corporation have made the following contracts:—1,000 KW. turbo-alternator (turbo, Fraser and Chalmers, Limited; alternator, Dick, Kerr), 6,600 volts, three-phase, 50 periods; switchboard, British Thomson-Houston Company, Limited; motor converters, Bruce Peebles and Company, Limited: marine type water-tube boilers and coal conveyor and bunkers, Babcock and Wilcox, Limited.

Siemens Brothers Dynamo Works, Limited, have received an acceptance of their tender for the supply of carbon filament lamps from the London County Council for the ensuing 12 months. Messrs. Siemens Brothers have also obtained a contract for the supply of Wotan lamps, Wotan half-watt and carbon filament lamps from the Aberdare Council for the ensuing 12 months, and for Wotan and tantalum lamps for Middlesbrough Corporation.

Messrs. A. and F. Manuelle's tender for the supply of Guernsey granite setts during the next 12 months has been accepted by the London County Council. The prices were as follows:—3,000 tons 3 in. by 6 in., 40s.; 1,000 tons 3 in. by 6 in., 43s. 6d.; 1,250 tons 3 in. by 6 in., 40s.; 1,500 tons 3 in. by 6 in., 40s.; 500 tons 4 in. by 6 in., 37s. The total net value of the tender was £15,802 10s. Half the quantities tendered for will be taken, and the delivery will be spread over a period of six months, instead of 12 months.

Cancelled German Contract.—The *Times* reports that some 18 months ago the Lambton and Hetton Collieries, Limited, of Newcastle-on-Tyne, decided to increase the efficiency of the Philadelphia power station, near Sunderland, and a contract for three turbines was entrusted to the Allgemeine Elektricitats-Gesellschaft, of Berlin. The contract has been cancelled and the order has now been diverted to British engineers and divided among Messrs. James Howden and Company, Limited, Glasgow; Messrs. W. H. Allen, Son and Company, Limited, Bedford; and Messrs. Siemens Brothers Dynamo Works, Limited.

"Vaughan" Rail Anchors.—The Railway Track Supply Company, 80, Gracechurch Street, London, E.C., inform us that they have just concluded arrangements with their agents, Messrs. Elder, Smith and Company, to manufacture the "Vaughan" rail anchor locally in Melbourne, to supply the Victorian Government Railways requirements. As a preliminary, an order has just been placed for 10,000 "Vaughan" rail anchors. This is another instance of encouraging home manufacturing in Australia. Recently, it will be remembered, it was reported that steel rails were being made locally for the South Australian Government Railways at Broken Hill.

London County Council have accepted the tender of Dick, Kerr and Company, Limited, for the roadwork and platelaying in connection with the reconstruction on the overhead system of electric traction of the tramways in Grove Road, Burdett Road, etc. The following tenders were received:

Dick, Kerr and Company, Limited (recommended for acceptance)	£60,566 9 5
W. Manders and Company	61,052 7 2
A. N. Coles, Limited	62,195 3 2
J. Mowlem and Company, Limited	63,041 16 11
J. G. White and Company, Limited	63,818 15 8
A. Stark and Sons, Limited	63,903 11 11
G. J. Anderson	64,337 19 3
W. Griffiths and Company, Limited	64,575 1 8
G. Wimpey and Company	66,514 4 0

Liverpool Tramways Annual Supplies.—The following tenders have been accepted for annual supplies to the tramways department:—Dick, Kerr and Company, Limited, motor equipments; British Hele-Shaw Patent Clutch Company, steel gears and pinions; Miller and Company, Moston Malleable Castings Company, and E. Wilson and Company, iron castings; L. Andrew and Company, Avon India Rubber Company, Hellewell and Company, North British Rubber Company, and New Liverpool Rubber Company, rubber goods, etc.; Baxendale and Company, Charles Booth and Company, W. B. Brown and Company (Blankhall), D. H. Collins and Sons, Ambrose F. Flere, Guest, Keen and Nettlefolds, G. K. Harley, D. Laybourn and Company, Marsh Brothers and Company, Fred Moore and Company, Perrin, Hughes and Company, Chas. Richards and Sons, Rowe Brothers and Company, ironmongery, etc.; D. H. Collins and Sons, D. Laybourn and Company, and S. Peace and Sons, steel, wrought iron and files; Vacuum Oil Company, M. Wells and Company, lubricating oils and greases.

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PERSONAL.

Mr. R. P. Wilson is now returning to London after a long visit to South America.

Mr. Fraser, of Kilmarnock, has been appointed tramway traffic manager of Darlington Corporation Tramways.

Mr. George Richardson has resigned his seat on the board of Metropolitan Tramways, Limited, on account of ill-health.

Mr. David Willock has been elected to a seat on the board of the Electric Construction Company, rendered vacant by the death of Mr. William Bulloch.

Mr George Balfour, of Balfour, Beatty and Company, Limited, has joined the Board of the Cordoba Light, Power and Traction Company, Limited.

Mr. T. P. Collinge, borough surveyor of Mansfield, has been appointed borough surveyor of Rotherham, at a salary of £500 rising to £700 per annum.

Mr. H. M. Taylor, borough electrical engineer of Middlesbrough, has been granted leave of absence by the Electricity Committee to join His Majesty's forces.

Mr. Max Muspratt has been congratulated by his colleagues on the Liverpool Tramways Committee on his appointment as Government Supervisor of explosive material.

Mr. Alexander Spencer, a director of Messrs. George Spencer, Moulton and Company, Limited, has been elected a director of the British Westinghouse Electric and Manufacturing Company.

Belliss and Morcom.—The following have been added to the board of this company:—Mr. John Belliss, M.I.Mech.E.; Mr. E. L. Morcom, B.A., A.M.Inst.C.E.; and Mr. F. O. Everard, M.Inst.C.E.

Mr. S. H. Barnett, Lower Edmonton, London, has been appointed temporary clerk in the Swindon Electricity and Tramways Department, to fill the vacancy caused by Mr. E. G. Barling joining the colours.

Lieutenant G. C. Milnes, electrical engineer of the Lancaster Electricity Supply and Tramways Departments, is on active service. Mr. J. B. Patterson, the works superintendent, is performing Mr. Milnes' duties in his absence.

Mr. J. R. Lilleker has been appointed assistant electrical engineer by Rotherham Town Council. Mr. Lilleker has been on the Rotherham staff for some years. He succeeds Mr. J. Williams, now electrical engineer and tramways manager at Erith.

Mr. R. K. Morcom, a director of Messrs. Bellis and Morcom, has been granted a commission in the Royal Naval Division and is going on active service, the directors having granted him leave of absence. Mr. N. A. Morcom has joined the Honourable Artillery Company.

Mr. W. M. Furniss has been appointed by the directors of the Electric Construction Company, Limited, as manager of the company's works at Wolverhampton in succession to the late Mr. William Bulloch. Mr. Furniss took up his duties as a manager on the 17th inst.

Sir Gilbert H. Claughton, chairman of the London and North Western Railway, was on March 10 elected chairman of the Railway Companies' Association for 1915, and Lord Bessborough, chairman of the London, Brighton and South Coast Railway, was elected deputy-chairman.

Captain H. Clifford Palmer.—The promotion is announced in the *London Gazette* of March 17 of Second Lieutenant H. C. Palmer to a captaincy. Captain Palmer is publicity manager of the General Electric Company, and is attached to the 14th County of London Regiment, generally known as the London Scottish.

Sir George Askwith, of the Board of Trade, Sir Francis Hopwood, of the Admiralty, and Sir George Gibb, of the War Office, have been appointed by the Government as a committee to settle differences between employer and employed, and so to prevent strikes Mr. H. J. Wilson is the secretary of the committee, whose address is 5, Old Palace Yard, London.

Mr. J. J. M'Mahon, electrical engineer of the overhead department of the Manchester Tramways, was a passenger on the torpedoed vessel "Aguila," and was rescued in the open sea by the s.s. "Lady Plymouth." Mr. M'Mahon was bound for the Canaries on holiday, and the "Lady Plymouth," being bound for that destination, he continued his voyage in that vessel.

Southampton Tramway Managership.—Out of 48 applicants for the vacant managership of Southampton Tramways, the following have been selected for further consideration:—Mr. H. Pilling, general manager and engineer of Accrington Tramways; Mr. F. Buckley, manager of Wigan Tramways; Mr. W. Billington, assistant to the general manager of the Salford System; Mr. W. T. Robson, general manager and engineer of the South Shields Tramways.

Mr. Marten Turner has been appointed general manager of the North Ormesby, South Bank, Normanby and Grangetown Railless Traction Company. Until the completion of the new offices of the company, Mr. Turner's address will be care of Mr. W. P. Ingham, Royal Exchange, Middlesbrough. Mr. Turner was for some years with the Colne and Trawden Light Railway Company up to the time of the transfer of that undertaking to the Colne Corporation and the winding up of the company. The railless traction system at North Ormesby is now under construction, and it is expected that the lines will be ready for working during the present year.

Glasgow Tramway Employee made a Lieutenant.—Lieut. Angus MacPherson, 2nd Argyle and Sutherland Highlanders, recently recommended for the distinguished conduct medal, was an employee in the Glasgow Tramways Department up till the beginning of the war. As a private in the 1st Scots Guards he was engaged in the fighting at Mons, the Marne, the Aisne, Ypres, and La Bassée, the young soldier being promoted to the rank of sergeant on December 10. He was mentioned in the despatches of December 25 and 27 and January 1 for particular devotion to duty. On February 4 he was gazetted lieutenant. Lieut. MacPherson, who is only 26 years of age, had the honour of being summoned to appear before the King.

Mr. James Bird, who has just been appointed Clerk of the London County Council, has been Deputy Clerk since 1905 Mr. Bird, who is 52 years of age, has been in the service of the Council and its predecessors since 1881, when he was appointed a member of the staff, after competitive examination. The General Purposes Committee of the London County Council, in recommending Mr. Bird's appointment as Clerk to the Council, said that during Sir Laurence Gomme's absence through illness in 1913, Mr. Bird performed the duties of Clerk of the Council in a completely satisfactory manner, and they had no hesitation in saying that his promotion would be in the best interests of the Council.

The late Mr. W. Edgar Allen, of Edgar Allen and Company, Limited, Imperial Steel Works, Sheffield, left £271,068 gross and £251,792 net. Various charities and employees benefit to the extent of £150,000. After various legacies are dealt with, he leaves two-fifths of the residue to the University of Sheffield, partly to the Committee of the Applied Science Department, and partly for founding Edgar Allen scholarships for students at the University.

INSTITUTION OF ELECTRICAL ENGINEERS.

Nominations by the Council of the Institute of Electrical Engineers for the new council for 1915-16 were issued on April 1. The Council desired unanimously to nominate Sir John Snell for a second year of office as President, but for reasons of health, and on account of the claims of professional work, he felt unable to undertake a second year of office.

Mr. C. P. Sparks has, therefore, been nominated. He is engineer-in-chief of the County of London Electric Supply Company, and has a large consulting practice.

Dr. Alexander Russell (Principal, Faraday House) and Mr. Roger T. Smith (electrical engineer to the Great Western Railway) are nominated as vice-presidents in succession to Messrs. W. Judd and C. H. Merz, whose period of office has terminated; the two vice-presidents, who remain in office, are Mr. J. S. Highfield and Mr. C. H. Wordingham. Mr. Robert Hammond is nominated for re-election as honorary treasurer.

There are five vacancies for ordinary members of council, and eight nominations have been made for the ballot next month: Mr. W. A. Chamen (engineer and manager of the South Wales Electric Power Distribution Company), Mr. H. Dickinson (city electrical engineer, Liverpool), Mr. H. W. Firth (electrical engineer to the Great Eastern Railway), Prof. T. Mather, F.R.S. (professor of electrical engineering, City and Guilds Engineering College), Mr. H. Faraday Proctor (city electrical engineer, Bristol), Mr. G. S. Ram (H.M. Electrical Inspector of Factories), Mr. W. Slingo (engineer-in-chief to the Post Office), and Mr. A. H. Walton (manager, Rugby Traction Department, British Thomson-Houston Company).

The five vacancies are caused by the retirement in the ordinary course of Messrs. F. Gill, W. Rutherford, A. H. Seabrook, and by the nominations of Dr. Russell and Mr. R. T. Smith as Vice-Presidents. The ordinary Members of Council who remain in office are Messrs. R. A. Chattock, J. Christie, Prof. B. Hopkinson, F.R.S., G. W. Partridge, W. H. Patchell, R. J. Wallis-Jones, and W. B. Woodhouse.

The three Associate Members of Council all remain in office, and are Mr. F. E. Berry, Major E. O. Henrici, R.E., and Mr. A. W. Martin. Mr. E. Russell Clarke and Mr. A. M. Ogilvie, C.B., remain in office as Associates on the Council, but Mr. H. C. Levis retires, and Mr. J. Hunter Gray (a well-known barrister in patent actions) is nominated in his place.

London County Council Highways Committee. The members of the Highways Committee of the London County Council, which controls the tramways, have been appointed as follows:—The Lord Monk Bretton, Sir John Benn, Messrs. D. Davies, G. A. Dutfield, H. H. Gordon, W. Haydon, G. H. Hume, William Hunt, Henry Marks, Theodore Prestige, A. Cooper Rawson, A. H. Scott, W. J. Squires, S. Joyce Thomas, Henry Ward, and A. W. Yeo. Mr. G. H. Hume has been re-appointed chairman of the Highways Committee, and Mr. Theodore Prestige has been appointed vice-chairman. Mr. G. H. Hume has been elected by the Highways Committee as their representative on the General Purposes Committee, and Mr. S. Joyce Thomas as representative on the Stores and Contracts Committee.

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TRAMWAY AND LIGHT RAILWAY NOTES

BRADFORD.

New Car Shed.

The Tramways Committee of Bradford Corporation surveyed the Bolton Road district on March 22 with a view to securing a site for a new tramcar shed nearer to the city. A place near Peel Park and another site were examined, but no decision was taken.

BELFAST.

Post Office Employees on Tramcars.

Under an agreement with the Tramways and Electricity Committee, Belfast postal authorities paid the sum of £1,250 per annum for the conveyance of postal officials on the tramcars while on duty. The period of agreement expired recently, and it was remitted to Mr. Andrew Nance, the tramways manager, to arrange a scheme instead of the agreement, in consultation with the postal authorities. Under the new scheme, tickets are issued to the Belfast postmaster at their face value, subject to a reduction of 25 per cent., for the use of post office officials on the tramways.

BURY.

Official Inspection of New Lines.

On Tuesday, February 23, Lieut.-Colonel Druitt, on behalf of the Board of Trade, inspected the extensions to the Limefield and Jericho sections of Bury Corporation Tramways. He was accompanied on his tour of inspection by Alderman Collinge, chairman of the Tramways Committee, Mr. J. A. Settle, borough engineer, and Mr. W. Clough, tramways manager. Colonel Druitt expressed himself as well satisfied with the work, and the running of the cars was subsequently officially sanctioned.

CARDIFF.

Employees' War Allowances—Free Rides for the Blind.

Sir John Courtis, chairman of the Tramways Committee, moved an important resolution at the meeting of Cardiff City Council, held on March 8. The resolution proposed that all employees of the tramways department who are married, or are single with dependents, who have enlisted, or who may enlist, should have their wages made up. It was provided that the resolution should not be retrospective, and that no employee should enlist without obtaining the sanction of the tramways engineer and manager. It was pointed out that other employees of the Corporation had enlisted, and were equally deserving of consideration. Sir John Courtis said that he had no objection to including all employees of the Corporation in the resolution. After discussion it was decided to refer the matter to the Wages Committee of the Council.—Mr. Arthur Ellis, electrical engineer and manager of Cardiff Tramways, has reported to the Tramways Committee on the proposal to grant free rides to the blind on their tramcars. Mr. Ellis stated that replies to his inquiries from 72 electrical tramway concerns show that in 39 cases the privilege was granted, the passes being issued from institutions for the blind. The committee agreed to postpone decision until after the war.

COLWYN BAY.

Completion of Extension.

The electric tramway line from Colwyn Bay to Old Colwyn is now completed and fully equipped, and all the contractors' plant has been removed. The road widening work which was necessary to accommodate the tramway traffic with the ordinary traffic is not yet finished in some places, but is being pressed forward. On Friday, March 26, Colonel Druitt, the Board of Trade inspector, will visit Colwyn Bay for the purpose of inspecting the new line, and if, as is expected, he is satisfied that it is satisfactorily constructed, the regular traffic will commence on the same day. The extension is nearly two miles in length, and will serve a considerable population on the route, as well as the residential and industrial population at Old Colwyn and Llysfaen.

CROYDON.

Capital for Extensions.

The Finance Committee of Croydon Borough Council submitted to a recent meeting of the Council two special reports on capital expenditure for the tramways. The first recommended application for a loan of £1,685 for additional loops on the Norwood and Addiscombe routes, £520 being for the Norwood route and £1,165 for the Addiscombe. The other recommended application for a loan of £1,272 for an auxiliary feeder cable on the Norwood route. Both recommendations were adopted.

DONCASTER.

Rolling Stock and Car Shed Extensions—Free Tram Rides for Councillors—Centre Poles.

The Town Council of Doncaster have adopted the recommendation of the Tramway Committee to expend £5,300 in additional tramcars, £1,850 in the enlargement of car sheds, £700 in covering in the Cheswold, and £500 for other subsidiary works in connection with the tramways. It is reported that Doncaster Town Council, meeting in committee, have resolved to grant themselves the privilege of free passes all over the corporation tramway system. The resolution will come up for confirmation at the next meeting of the Council. It was stated at a Council meeting, on March 3, that the Light Railways Committee intended to remove all the centre poles in the streets. Action was deferred, however, owing to the increased cost of doing the work during the war.

DUBLIN.

Tramway Company's Coal Supply.

A statement was made at the meeting of Dublin Corporation early in March to the effect that the Tramways Company would not be able to carry on their undertaking for want of coal. In response to the inquiry on the subject, Mr. W. M. Murphy, chairman of the Tramways Company, characteristically replied that he would guarantee the Councillor who made the statement against any additional wear and tear of shoe leather caused by the want of trams.

EAST HAM.

Extension of Speed Limit Required.

At the recent meeting of East Ham Town Council, the manager of the Corporation Tramways reported that the police had taken proceedings against two of the Council's motormen for exceeding the speed limit in Romford Road. It was agreed, on the recommendation of the Electric Lighting and Tramways Committee, that the Town Clerk be instructed to apply to the Board of Trade for the speed limit of the Council's tramcars on these highways to be increased to 12 miles per hour.

EDINBURGH.

Temporary Curtailment of Corporation Schemes.

The tramway projects of Edinburgh City Council are not likely to be important during the war. Even if they obtain the Parliamentary powers sought, only a small extension and some street widening will probably be undertaken this year. The erection of the electric power-station at Portobello, however, will be proceeded with, and estimates will shortly be invited for the construction of the buildings.

FIFESHIRE.

Extension of Time.

In their annual report, submitted to a meeting of shareholders held on Wednesday, February 24, the directors of Fife Tramway Light and Power Company state that, as their statutory powers for the construction of a tramway to Rosyth Naval Base and Inverkeithing expire in July, 1915, they have applied for an extension of time, and also for powers to construct a connecting line along the North Queensferry Road.

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GLASGOW.

SHORTAGE OF STAFF.

Mr. James Dalrymple, general manager of Glasgow Corporation Tramways, has reported to the Tramways Committee that he is still 300 men short of the regular staff, and that conductors and motormen are working practically seven days a week. In view of the scarcity of men to act as conductors, a deputation of the Women's Suffrage National Aid Corps has suggested to the Tramways Committee that women should be employed as conductors at the same wages and on the same conditions as men.

HALIFAX.

TRACK DOUBLING.

The Tramways and Electricity Committee of Halifax propose to carry out certain doublings of the existing tramways in the Halifax and Bradford Road, at an estimated cost of £912.

HULL.

COAL SUPPLY AND INCREASING EXPENSES.

At a meeting of the Hull Corporation Tramways Committee on March 24, reference was made to the need of supplementing the supply of power and the rise in the price of coal. A recommendation from the Corporation Coal Committee that no tenders for coal be entered into at present was adopted, and it was agreed to make purchases as the service required. On the present prices, it was stated, the increase in the cost of coal would represent about £2,000 on the year. The Lord Mayor (Mr. Hargreaves), who presided, said the position was abnormal. The Committee were going to be faced with a £6,000 increase in wages, £2,000 in coal, and, as all other stores might be expected to rise in similar proportion, he might say they would be faced with extra expenditure of £10,000. The Lord Mayor, replying to a member who suggested that the question of fares should be dealt with, said the Committee would do nothing in a hurry; the whole matter needed great consideration. There were only two ways of dealing with the situation, one of which must be adopted. It was impossible to carry on the service as it was being carried on to-day on account of the shortage of men, and the Committee would have to consider in the near future whether they should not take off what he might call some of the "luxury cars." At such a time as this some inconvenience must be borne all round.

LEEDS.

TOKENS FOR SPECIAL CONSTABLES—GUISELEY EXTENSION.

The Leeds Watch Committee has decided to purchase tokens from the Tramways Committee to be supplied to the special constables in order that they may use the cars in travelling to and from points of duty without payment.—The tramway line from Boar Lane, Leeds, to Guiseley has been extended by three-quarters of a mile. Good progress has also been made on the trackless system being carried forward to Burley and Otley, in Wharfedale. Mr. J. B. Hamilton, the general manager, has stated that he hopes to commence the service at the end of May or early in June.

LEICESTER.

LOANS FOR TRAMWAY ROAD IMPROVEMENTS.

At Leicester, on March 22, Mr. R. H. Bicknell, Local Government Board Inspector, held an enquiry into the application of Leicester Town Council for sanction to borrow sums of £1,994 and £3,817 for street improvements. In connection with the first item of £1,994, the Town Clerk explained that it was for the carrying out of a scheme of widening the Lutterworth Road at the boundary of the borough, a little beyond the Aylestone tram terminus. The Road Board had been approached with a view to a grant being obtained, this being an improvement of the nature contemplated by the Board. After consideration, the Board had consented to give a grant of £586 under certain conditions, and it was hoped that this amount of relief would be secured. The second item of £3,817, which the Corporation desired to borrow, was, the Town Clerk explained, for the purpose of carrying out the widening of the Welford Road at various points, involved mainly by the construction of the new tramway route. It was hoped in this instance, too, that a grant would be obtained from the Road Board. Mr. Mawbey submitted plans of the proposed improvements, and explained the details of the work to be done. There was no opposition, and the enquiry was closed.

LIVERPOOL.

SPECIAL COMMITTEE TO CONSIDER WAGES.

At the meeting of Liverpool City Council held on March 3, the following resolution was moved by Sir Charles Petrie:—"That a special committee be appointed to consider and decide what increase, if any, should be made in the salaries and wages of the officials and servants of the Corporation, including those employed temporarily, owing to the rise in the cost of the necessities of life since the commencement of the war, and as to the period during which such increase shall be given, and that the following members of the Council be appointed members of the special committee:—The chairman and deputy-chairman of the standing committees, Sir William Bowring, Alderman Salvidge, Mr. Burton Ellis, Mr. Lawrence D. Holt, Mr. Max Muspratt, Mr. Henry Jones, Mr. Alfred Gates, Mr. R. G. Hough, Mr. James Sexton, Mr. W. A. Robinson, Mr. John Clancy, and Mr. Richard Rutherford."

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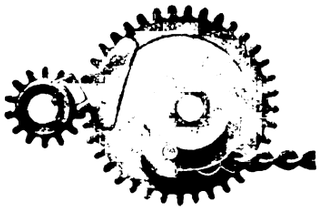

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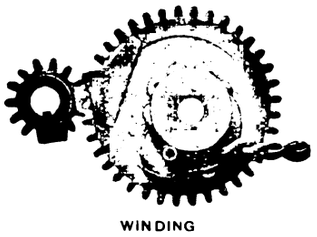

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LOWESTOFT.

TRACK REPAIRS.

The engineer of Lowestoft Corporation Tramways reported to the Town Council meeting on March 10, that the condition of the track on certain portions of the route was in need of repair. He was instructed to proceed with the repairs at an estimated cost of £300.

NOTTINGHAM.

BETTER LIGHT POSSIBLE WITHIN MILITARY REGULATIONS.

It is reported from Nottingham that a well-known firm has fitted all the Corporation cars with shades for the car lights which effect the same purpose from an aerial point of view as the darkened lights at present in use, and at the same time afford a much improved light for those inside the car.

SHEFFIELD.

EXTENSIONS OF TRAMWAYS CLUB—SELLING PAMPHLETS ON CARS.

At the meeting of Sheffield City Council held on March 10, Sir William Clegg, chairman of the Tramways Committee, stated that it had been decided to make an extension to the Tramways Club, the accommodation there having become too small for the increased number of employees in the department. The cost would be advanced out of the accumulated tramway surplus, and would be repaid by the employees in an agreed term of years. At this meeting Alderman Marsh moved:—"That this Council disapproves the recent action of the Tramways Committee in authorising the sale by the tramway and omnibus conductors of pamphlets of a controversial nature, and instructs the Tramways Committee that in future the employees of the Tramways Committee shall not be engaged in the sale of literature, and that no notices or advertisments shall be published in the tramcars and omnibuses except such as are inserted by the authorised advertisement contractors, or relate to recruiting, or to the raising of relief funds by the Corporation, or to collections in aid or on behalf of philanthropic societies or associations."

SOUTHAMPTON.

NO MORE FREE RIDES.

Southampton Town Council remitted to the Tramways Committee some time ago the question of withdrawing from the military forces the privilege of free rides on the tramcars, and it was decided that the privilege should be withdrawn on March 15. Under the Southampton Tramways Act, soldiers and sailors enjoy the right of travelling the full distance on any line for one penny.

STOKE-UPON-TRENT.

LEASE OF POTTERIES ELECTRIC TRACTION COMPANY.

The County Borough Council of Stoke-on-Trent has had under consideration for some time the question of renewing the lease of the tramways in the borough to the Electric Traction Company. The proposal of the majority of the Council is to renew the lease for a period of 25 years, but a strong minority, consisting chiefly of Labour representatives, hold out for purchase of the tramways by the local authority. The draft agreement, which stipulates for certain payments by the company to the Corporation and improvements in the system, has been provisionally accepted by the Council, and a committee consisting of representatives of the six pottery towns appointed to consider details and report to a future meeting of the whole Council.

WEST HAM.

SANCTION FOR LOAN FOR PURCHASE OF CARS.

West Ham Town Council proposes to apply for sanction for a loan of £3,000 to cover the difference between the revised estimate for the purchase of 15 bogie cars and one single-truck car and the amount already sanctioned, and for £10,000 for car equipments. The latter amount is the sum required after deducting £18,000, which will be taken from the reserve fund.

WOLVERHAMPTON.

COMPENSATION LOST IN LAW EXPENSES.

At a recent meeting of Wolverhampton Town Council, a letter was read from the widow of motorman Simcox, who died while on duty on a tramcar, asking reconsideration of her case. It was stated that before the claim for compensation was raised by the widow in the County Court, she was offered £52 in settlement of her claim, but the offer was refused. At the hearing of the case the Court decided against the widow's claim, and the insurance company which defended the case incurred £57 of expenses. The Council decided that it was now too late to reopen the question, but referred the matter to the Tramways Committee for consideration.

War Bonuses at Paisley.—The directors of Paisley District Tramways Company have resolved to pay each employee, over and above his or her normal wage, a war emergency bonus. The scale is adjusted on the basis of 1s. per week to those having a normal wage not exceeding 20s. per week, and 2s. to all over 20s. per week. The allowances are to date from March 1, and will be paid every four weeks The directors, in intimating the bonus, take the opportunity of thanking the staff for their loyal support during the absence on service of the general manager and other members of the staff.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

3,234 Railway brakes—F. E. Feesy.
3,242 Brake for vehicles—H. Barmby.
3,246 Gate-closing mechanism for tramcars—J. M. Stuart.
3,252 Ticket punches—A. C. Cronk and W. Mottershead.
3,311 Steam generators for motor road vehicles—T. Clarkson.
3,340 Fluid-pressure braking apparatus—A. W. Rendell.
3,350 Steam superheaters for locomotive boilers A. Spencer.
3,358 Railway crossings—J. W. East.
3,383 Means for expediting and safeguarding railway traffic—H. A. Thompson
3,386 Railway signalling apparatus—E. Sutton.
3,400 Protective covering for solid rubber tires—J. E. Blurton.
3,419 Signalling systems—A. Stern.
3,472 Brakes for motor vehicles—R. R. Mellor and T. M. G. Morton.
3,477 Automatic railway coupling—F. E. Applegate.
3,520 } Electric signalling systems—International Electric Company,
3,523 } Limited, H. E. R. Roose and R. G. le Noir
3,526 Superheaters—G. M. Clark *(Locomotive Superheater Company)*.
3,539 Wheels with increased tread on track—B. C. Riblet.
3,579 Compresed air brake—F. J Chapsal and A L. E. Saillot.
3,581 Motor vehicles J. C. Lobato.
3,679 Rail tie—B. J. Sheehe.
3,694 Springs for motor vehicles—R. Esnault-Pelterie.
3,712 Railroad ties—W. V. Polick.
3,728 Renewal of the wearing parts of trolley wheels of electric tramcars L. Loukes and W. J. Hunter.
3,774 Electric signalling apparatus—E. Walker
3,796 Collector gear for overhead trolleys—T. G. Poole.
3,902 Struts for bogies of railway vehicles—Leeds Forge Company, Limited, and R. G. Sharp.
3,910 Magnetic clutches, brakes, etc. Compagnie de Fives-Lille.
3,928 Bonding devices for electrical conduit systems—D. L. J. Broadbent.
3,943 Route indicators for railway signalling—J. P. O'Donnell and S. L. Glenn.
3,948 Vacuum brake apparatus—E. S. Luard.
4,060 Lubricating axles of locomotives, tramcars, etc.—H. Hobson and A. Morris.
4,120 Differential gear for motor vehicles L. W. Williams and R. Ainsley.
4,149 Railway signalling—W. R. Sykes Interlocking Signal Company, Limited, and R. W. Tarrant.
4,178 Starting devices for the engines of motor cars—A. Orr.
4,222 Motor control—Akt.-Ges. Brown, Boveri, et Cie.
4,423 Devices for controlling the speed of motor vehicles—J. H. Wilson and A. W. Romyn.
4,461 Tires for motor road vehicles—E. D. Self.
4,463 Folding signalling apparatus—A. J. M. Shaw.
4,484 Automatically variable gearing—A. R. Monro.
4,492 Lifting-jacks—T. H. Tessier and W. Dinnage.
4,495 Frame and cover for motor omnibuses and trams—C. T. Lunnis.
4,548 Change-speed gearing for motor vehicles—G. H. Robinson.
4,691 Lifting jacks or devices J. F. Gregory.
4,728 Railway and like signalling—A. Kerr.
4,741 Reinforced concrete sleeper and rail-tie—E. W. Manning.
4,747 Electric motor controllers—Igranic Electric Company, Limited (Cutter Hammer Manufacturing Company).

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4,757 Transmission of signals to railway and tramway vehicles—W. F. J. H. Bouman.
4,790 Compound rail—W. A. Seeley.
4,798 Brake mechanism for road vehicles—W. T. Bell and L. W. Jones.

SPECIFICATIONS PUBLISHED.

1913.

26,326 Train warning signals—Goddin and Griffiths.
29,435 Axle boxes for rail vehicles—Lassmann.
29,540 Wheels for vehicles—Dunlop Rubber Company and Wright.

1914.

641 Railway signalling apparatus—Buenos Ayres and Pacific Railway Company *(Harte)*.
3,596 Current collecting devices for dynamo electric machines—British Thomson-Houston Company and Whitaker.
3,925 Electric power transmission, self-starter, and lighting system for motor vehicles—Roydhouse and Cheeseman.
9,436—Car trucks—Adams.
10,066 Brake mechanism for railway vehicles—Bowles.
11,221 Axle boxes—Pettigrew.
11,295 Superheaters—Stenning.
11,417 Steam superheaters—Litton.
12,847 Bogies of railway vehicles, etc.—Haigh.
15,086 Railway sleepers or ties—Brockway.
901 Electric railway and tramway systems—Aspinall.
2,459 Rear-axle drive for motor-propelled road vehicles—Proud and Proud.
4,332 Signals for railways—Davies and Morgan.
8,782 Road wheels for motor vehicles—Hayman and Hayman.
19,513 Vehicle brakes—Dutcher.
3,568 Detonating signals for use on railways—Ramsbottom.
4,554 Electric motor control systems—British Thomson-Houston Company *(General Electric Company)*.
5,341 Railway tie-bars and sleepers—Todd.
5,608 Foot-operating mechanism for motor vehicles—Daimler Company and Berriman.
5,903 Communicating with trains—Thompson.
9,415 Railway chair keys and wedges—Bowen.
16,492 Self-contained buffers for rolling stock—Watson and Boyd.
19,944 Electric railway systems—Mullaney.
5,351 Electrical train-controlling systems for railroads—Warthen.
5,513 Electro-magnetic brakes, etc.—J. P. Hall and Company.
5,854 Valve apparatus applicable for use with automatic vacuum brakes—Vacuum Brake Company, Dover and Walker.
8,340 Cover for seats of omnibuses, trams, etc.—Hickman.
10,025 Motor vehicles—Guy.
10,767 Brake mechanism for motor road vehicles—Daimler Company.
11,042 Steering hand-wheels for motor road vehicles—Bluemel Bros.
22,304 Railway trucks—Mower and Thursfield.
23,342 Axle boxes for railway vehicles—Woodhead and Elliott.

1915.

516 Means for operating the collapsible cover for the upper deck of omnibuses and tramcars—Beck.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. Mar. 7.	Mar. 14.	Mar. 21.	Mar. 28.	1915. WEEKS ENDED. Mar. 6.	Mar. 13.	Mar. 20.	Mar. 27.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	
Anglo-Argentine	58,529	59,392	55,913	56,302	51,890	50,619	53,433	51,827	12	610,676	– 74,579
Auckland	(28 days) 23,332	...	...	...	(28 days) 19,907	..	...	...	36	186,935	+ 4,513
Burma	4,323	4,042	4,207	4,298	3,344	3,483	3,624	3,774	...	...	– 36,947
Calcutta	Rs. 70,006	67,630	65,616	64,708	66,531	64,137	62,741	62,259	13	884,622	– 52,419
Hong Kong	$ 11,407	11,036	11,134	11,264	10,840	9,974	9,800	9,776	13	141,905	– 16,977
Madras	Rs. (2 weeks) 29,347	...	...	...	(2 weeks) 27,730	...	...	...	10	136,229	– 3,050

Companies Issuing Monthly Statements.

	1913 Oct.	Nov.	Dec.	1914. Jan.	Feb.	March.	1914. Oct.	Nov.	Dec.	1915. Jan.	Feb.	March.	Wks.	AGGREGATE. 1915.	+ or –.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Brazilian Traction Mlrs	6,098,850	6,009,487	6,142,209	6,194,227	...	...	6,241,170	5,929,730	6,010,490	5,996,190	...	...	5	5,996,190	– 198,037
Brisbane	27,250	27,053	29,145	28,330	25,260	...	28,763	28,600	30,890	29,620	26,590	...	9	56,210	+ 2,620
British Columbia $	753,541	746,152	793,219	777,102	...	...	661,000	648,485	674,063	640,495	...	...	31	4,639,394	– 691,434
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	12,223	...	14,147	14,646	13,342	...	12,682	...	15,869	15,660	13,924	...	9	29,584	+ 1,596
Carthagena & Herrerias	1,582	1,922	2,698	2,776	2,919	...	1,543	1,379	1,255	904	1,822	...	9	2,726	– 2,969
Cordoba	13,278	...	12,863	...	...	...	12,919	...	12,119	...	...	...	39	119,457	– 845
East India	1,878	1,922	2,046	1,938	1,701	...	2,007	2,029	1,839	1,914	1,649	...	30	13,530	+ 12
Kalgoorlie	2,652	2,504	2,907	2,340	...	...	2,525	2,414	2,905	2,372	...	...	5	2,372	– 32
La Plata	4,920	5,409	5,505	5,296	4,766	...	4,540	4,540	4,452	4,540	4,016	...	9	8,556	– 1,506
Lima	35,175	33,236	38,091	37,870	33,779	...	30,648	29,749	32,112	33,042	30,173	...	9	63,215	– 8,434
Manila $	148,000	154,950	154,000	137,000	153,300	...	125,750	129,000	132,500	127,500	123,000	...	9	250,500	– 39,800
Melbourne	65,000	68,767	...	68,500	...	...	63,328	66,402	...	62,729	...	...	5	62,729	– 5,771
Mexico $	616,007	605,467	...	...	...	...	558,990	643,961	...	...	...	...	47	6,716,716	+ 378,911
Montevideo	...	30,531	33,310	38,256	35,805	...	...	27,081	28,605	32,443	30,007	...	17	118,136	– 19,765
Port Elizabeth	3,553	...	4,367	4,830	3,510	...	3,372	...	3,986	4,102	3,149	...	9	7,251	– 1,089
Puebla $	63,000	69,700	65,600	...	...	...	49,100	45,900	40,000	...	...	...	52	669,500	– 44,500
Rangoon	5,963	5,686	5,424	5,163	5,009	...	4,600	4,405	4,459	4,689	4,991	...	9	9,680	– 492
Toronto $	861,235	849,279	...	847,945	...	...	849,636	824,634	...	843,351	...	...	5	843,351	– 4,594
Winnipeg $	357,313	360,082	379,863	382,670	...	...	330,562	330,398	368,400	350,681	...	...	5	350,681	– 31,989

(*Continued on page 288*)

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proportionate provision for the necessary renewals. . . . . I am quite sure that the discontinuance of the ½d. fares on the Ilford system would undoubtedly result in materially improving its financial position."

The manager of the Dundee tramways says: "Looking at your accounts it is perfectly evident that your earnings per car mile are too low for tramways. I have no hesitation in saying that you cannot afford to carry passengers over three-quarters of a mile for ½d."

The manager of the Glasgow tramways says: "It is quite absurd to imagine that with such a large percentage of ½d. fares as you have and to be only able to carry an average of 9·7 passengers, you can ever hope to meet expenses. . . . . I think the case of Ilford illustrates very clearly that it is quite impossible, on a small system, to rely as much as you do on ½d. fares. . . . . There is no doubt that it is about time you made some change in order to increase your revenue. Your expenditure appears to be very reasonable."

A number of other managers express similar opinions, and amongst them the manager of the Liverpool tramways emphatically says: "I quite agree with your views on the matter, that there is no likelihood of your undertaking ever being financially sound so long as ½d. fares are in existence."

As I have said, there is a concensus of opinion from these eminent men of the tramway world that ½d. fares are absolutely unsound for small systems, and we must assume that they have carefully studied the question and that their opinions are the result of mature consideration. It is therefore reasonable to deduce from these opinions and from the figures I have given that the ½d. fares are the cause of our bad financial condition. Such being the case, it behoves us to see whether a change for the better can be made, and I offered you the advice, carefully considered and recognising my responsibility in the matter, that you should abandon the ½d. fare and substitute therefor a system of 1d. fares only.

I am well aware that this is a drastic course, but serious maladies require drastic remedies. It is to be expected that a certain section of the public will abstain from riding on the cars at first, not because they cannot afford the increased fare, but from a feeling of resentment, and in addition the experiment will have been adversely criticised long before the actual results and figures can enable us to form a sound judgment upon the matter. Tramway business, perhaps, more than any other, depends for its success on the good feeling with the general public, and adverse criticism and recriminatory discussion will certainly for a time affect the receipts, but it is reasonable to suppose that after this has died down a large percentage of passengers who at first boycott the trams will bow to the inevitable and return to them, and this is amply borne out by the experience in other towns where a rise of fare has been made, such as Leith, Newport, Stalybridge, etc., as shown in the reports in the appendix.

Another point to be noted is that if ½d. fares are abolished and 1d. ones substituted, that the work of the conductors and the ticket staff will be much simplified, and the former will have more time to collect fares and to pay attention to their platforms and passengers, and to look out for intending travellers and prevent accidents in boarding and leaving moving cars.

I fully recognise that the question of abolishing the half-penny fares depends upon the line of policy our competitors, the 'Bus Company, are likely to adopt, but to my mind the only reason they are running their present half-penny fares is because we compel them to do so. Undoubtedly it does not pay them any more than it does us. So far as I know, they have never pretended to carry the public for any other purpose than to make profits for their shareholders, and it is to the interests of both of us that we adopt similar fare stages.

Were we to alter our fares I believe they would be only too quick to do the same. It must be recognised that the 'buses are here to stay, and that we shall always be in competition with them for the patronage of the travelling public. If, however, the Committee think it would be rather a bold step to take, and would prefer that I should first approach the 'Bus Company with a view to a working arrangement, I will do so, but, as I have said above, I do not think this is absolutely necessary.

1d. "Universal" Fare.

You will remember that in my original report in July, 1913. I suggested that 1d. universal fare should be charged in any direction from the Clock Tower in the Broadway, but I have given careful consideration to the objections and suggestions made at that time to that scheme, and to meet them I now suggest that two additional 1d. stages be made, viz., between Seven Kings Station and Barking Station, and between the Bell Inn and Barking terminus, the latter being effected by a transfer ticket available for changing cars at the Broadway and continuance of the journey by the next following car.

This will meet the objection that under my original scheme a passenger wishing to travel from, say, Christchurch Road to Grange Road, or, say, from Connaught Road to Khartoum Road, would have had to pay 2d. instead of the present two ½d. fares. . . . . .

The distances given for the 1d. fares will then be as follows:—

Broadway—Chadwell	4,860 yds.	=2·76 miles.
Broadway—Barking Terminus	3,045 ,,	=1·73 ,,
Broadway—Barkingside	4,550 ,,	=2·58 ,,
Barking Station Seven Kings Station ..	4,791 ,,	=2·72 ,,
Barking Terminus—Bell Inn	4,305 ,,	=2·45 ,,

I have always held the opinion that once a passenger has boarded the car and paid a 1d. fare, that it does not much matter, within reason, how far he is carried for that sum. The cost of his conveyance for 1 or 2 extra miles is extremely small provided his original fare pays for the cost of standing charges plus a margin for working costs, and this principle has been proved up to the hilt on the South Shields tramways, where the manager says, "It is nearly two years since we adopted a universal 1d. fare, with a most successful result; although it is possible to ride nearly 3½ miles for a 1d., we have experienced both an increase in the number of passengers and a substantial increase in the receipts."

Hull's tramways manager also says, "We had a 1d. universal fare up to seven years ago, and it founded the concern on a most secure and firm basis. I trust your Council will take the bull by the horns, act upon your suggestion, and endeavour to retrieve the position." A number of other managers also say that, from consideration of the data I have given them, that a universal 1d. fare must be the best thing for the Ilford system.

I will now consider the question as to the probable effect of the change upon our takings, and in arriving at my figures I will not go upon the passengers carried during the last financial year, although they would be more favourable, but I will base them upon the results since June 1st last, when the Barking lease commenced. Since this date, of course, the proportion of 1d. passengers to the whole number carried has increased considerably.

Passengers carried in 32 weeks of this financial year since Barking lease commenced, viz., June 1, 1914—Jan. 10, 1915:—

½d.	2,961,431	2½d.	21,304
1d.	2,106,239	1d. W.	186,170
1½d.	377,835	2d. W.	26,900
2d.	75,123	3d. W.	1,908
			5,756,910

Receipts: £19,173 3s. 3½d.

From these figures the average for 52 weeks is:—

½d.	4,812,325	*2½d.	34,719
*1d.	3,422,638	*1d. W.	302,526
*1½d.	613,982	*2d. W.	43,712 × 2 = 87,424
*2d.	122,069	*3d. W.	3,100 × 2 = 6,200

Receipts: £31,166 9s. 11d.

*Under the scheme these would be 1d. fares, totalling 4,589,558.

We have therefore a period of 32 weeks to go upon which is a very fair proportion of the year, and we can derive fairly accurately the probable number of each fare for the whole year.

Our receipts give £31,166 9s. 11d., or 7,477,548 pence.

It is therefore clear that we should require:—

7,477,548—4,589,558 = 2,887,990 ½d. passengers to consent to pay 1d. in order that our receipts still remain the same, or, in other words, we could afford to lose 1,924,335 ½d. passengers and still take the same money. I do not think it unreasonable to assume that we should *not* lose nearly two million passengers through the change, and not only this, but we should certainly have an increase from the present passengers using the 1½d., 2d. and 2½d. stages; there will be more patrons for these stages when they are reduced to 1d.

There is one ½d. stage, however, which we shall be bound to retain, and that is the stage in the Barking area from the terminus to Loxford Bridge. Although there is no express mention of it in our agreement, still throughout the negotiations between myself and the Barking manager it was tacitly assumed that there would be no alteration in the fare stages in Barking itself, and in my opinion we should certainly respect this arrangement. I would also advise that half fares be issued to all children between 3 and 12 years of age.

With regard to workmen's fares, our Act of Parliament, Section 30, says that the rates of charges for artisans, mechanics and daily labourers shall not exceed ½d. per mile (the lessees nevertheless not being required to take any less fare than 1d.), and Section 27 says that any fraction of a mile beyond an integral number of miles shall be deemed a mile. We should therefore be quite justified in not giving any further facilities to workpeople than the 1d. stages above enumerated.

After careful consideration, however, I advise that 1d. return tickets be issued to workmen for any 1d. stage on any car leaving the terminus up to 7 a.m., and to workwomen on any car leaving a terminus up to 8 a.m., Barking, Chadwell and Goodmayes being the termini of the High Road route, and the Broadway, The Horns, and Barkingside being the termini on the Ley Street route.

The return halves to be available for return journey on day of issue only.

In conclusion, I would say that I am confident every member of the Tramways Committee will give this matter his most careful attention and thought, but that some will still remain doubtful as to

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whether my arguments are sufficiently sound to induce them to make such a radical change in face of opposition for the time being from the travelling public. To those I would say that although I am personally satisfied that the scheme will be a success I realise their possible hesitancy upon the matter, and I suggest that they should give the scheme a trial for one year from April 1st next, and if it does not prove to be the success I confidently anticipate, then the old fares can be reverted to, but if on the contrary it is found that the takings have not suffered, and that the public have recognised that they must pay at least cost price for the ride they take, then the scheme can continue.

I append the opinions of 80 tramway managers upon the question of ½d. fares in general and on their effect on the Ilford system in particular, and I am sure that it will be your wish, whatever the outcome may be, that I should here express your sincere thanks for and appreciation of the valuable time and careful thought they have given to the replies to my queries.

P.A.Y.E. CARS IN ABERDEEN.

TRAMWAYS COMMITTEE CAPITULATE TO ORGANISED OPPOSITION.

The Town Council of Aberdeen held a special meeting on March 15, to consider the report of the Tramways Committee on the question of retaining or abolishing the P.A.Y.E. system on their cars. The Tramways Committee submitted the following resolution:—

"With reference to the minute of Council of date 1st inst., the committee have again had under consideration the question of the continuance of the P.A.Y.E. system of collecting fares on the Corporation cars. Having regard to the nature and extent of the opposition to the system on the routes where it has been in operation, the committee are of opinion that it is not expedient to continue any longer the P.A.Y.E. system of collecting fares, and accordingly resolve to recommend that it be now discontinued."

Bailie Robertson moved the adoption of the Tramways Committee's report. He could not say he was doing it with very great pleasure. He had always maintained that the pay-as-you-enter system had never had a fair chance. (Hear, hear.) The majority of the committee were of the same opinion. At the same time the cars were there for the people's use, and when the public objected, that ended the matter. The Tramways Committee had been of the opinion that there should be no change until the month of August. The matter had been before the Town Council on three occasions already, and had always been sent back. He did not see any use in wasting the time of the Council in discussing the matter further.

Councillor Reith seconded. It was perhaps a little humbling for the committee to come with that recommendation, but the cars belonged to the people, and as ex-Baillie Robertson had well said, they had a perfect right to say whether it should be the P.A.Y.E. system or any other. An amendment was proposed and seconded, but the motion was carried by 19 votes to 12. It is to be noted, however, that a number of those who voted for the resolution are in favour of the P.A.Y.E. system, but agreed that it should be abandoned meanwhile in deference to what appeared to be the will of the ratepayers and the users of the cars.

LONDON'S DEBT.

TRAMWAY INVESTMENT OF NEARLY TEN MILLIONS.

The aggregate net debt of London secured on the rates on March 31, 1914, was £108,606,825. During the year 1913-14 the fresh debt created amounted to £2,443,560. A large portion of the increase was incurred for revenue-producing services. The total net debt on March 31, 1914, was equivalent to 246·35 per cent. of the rateable value of London. The net debt attributable to revenue-producing undertakings was stated by the Finance Committee, in a report to the Council dated March 10, to amount to over 50 per cent. of the total, and is as follows:—

SERVICE.	MARCH 31, 1914.	MARCH 31, 1913.	INC. OR DEC.
Water supply (Metropolitan Water Board)—London's rateable proportion	39,455,767	39,451,765	+ 1,002
Tramways (London County Council) ..	9,923,529	9,882,881	+ 40,648
Electricity Undertakings (Metropolitan Borough Councils)	5,563,277	5,450,463	+ 112,814
Working-class dwellings (London County Council & Metropolitan Borough Councils)	3,486,664	3,464,845	+ 21,819
Miscellaneous	46,693	47,750	— 1,057
	58,475,930	58,300,704	175,226

The revenue of each of the undertakings mentioned above constitutes a primary security for the loans raised therefor, and the liability of the ratepayer for debt charges is only a contingent one. So long as the revenue is sufficient to meet the expenditure, including the charges for interest and repayment of capital, no charge will fall on the ratepayer.

BRISTOL TRAMWAYS EXTENSION SCHEMES.

AN INTERESTING SITUATION.

The Bristol Tramways and Carriage Company, as previously reported in these pages, are promoting a bill in Parliament to extend the time within which the company may construct certain lines of tramways authorised in 1904. The new lines are of a total length of over seven miles, and extend both within and without Bristol City boundary. In their note on the subject to the Town Council, the Parliamentary Bills Committee, after giving the details of the proposed new lines, report as follows:—"Though the lines are largely outside the City boundary, it must be remembered that by the Bristol Corporation Tramways Act, 1914, the Corporation are required, if they decide to purchase any tramways, to take the whole of the company's tramways, whether inside or outside the city, and therefore the Corporation now have an interest as potential purchasers in any tramways constructed outside the city which they did not formerly possess. With regard to the tramways to be constructed within the city, your committee consider that if the powers now asked for are granted the Corporation should have an opportunity of showing that the nature of the traffic using the roads to-day, as compared with the traffic conditions prevailing when the tramways were authorised, in 1904, renders it necessary for the Corporation to obtain further protection; and with regard to the tramways to be constructed outside the city, the present occasion is the first opportunity afforded the Corporation of criticising the conditions under which those tramways are to be constructed. Your committee are also of opinion that, inasmuch as the option of the Corporation to purchase the company's tramway undertaking arises on May 1 next, and may be exercised at any time within six months thereafter, the company ought not to enter into any agreements for laying down new tramways before the date when the option of purchase expires. Your committee have asked the Tramways Company to give an undertaking to this effect, but as the company did not see their way clear to comply with the request, your committee considered it advisable to lodge a petition in Parliament against the Bill, with the object of preserving the right of the Corporation to be heard in Parliament upon the foregoing matters, and your committee now ask that they be authorised to take all such steps as may appear to them necessary for safeguarding the interests of the Corporation."

YORKSHIRE TRAMWAY MANAGERS' ASSOCIATION.

A meeting of the Yorkshire Tramway Managers' Association was held at the Leeds Tramway Offices on March 11. Mr. J. B. Hamilton was in the chair, and amongst others present were:—

Messrs. A. R. Fearnley (Sheffield), W. J. McCombe (Hull), H. L. White (Grimsby), E. A. Paris and E. Parkinson (Heavy Woollen District), W. E. Nicholl (Scarborough), J. D. Caird and J. Galloway (Halifax), P. Priestley (Mexborough), W. McGibbon (Ossett), H. England, hon. sec. (Wakefield).

This informal association, which comprises the tramway managers of Yorkshire, Lincolnshire, and North Derbyshire, was formed in the summer of 1905, so that it has been nearly ten years in existence. During that time much good work has been done, and the meetings have given pleasure and profit to those who have attended. It has, however, been found difficult latterly to arrange meetings in the spring and summer months, as many of those desirous of attending are then engaged in other directions, and as each tramway system has been visited in rotation, the distances to be travelled were often found very considerable, necessitating a full day's railway journey.

In the early days of tramways, before equipments and material were more or less standardised, there was always something to be learnt when visiting even the smallest of systems, but things are now changed, and in consequence the Yorkshire managers have decided to reorganise their association. In future only two meetings each year will be held, in the months of November and March, instead of four as hitherto, and with a view to holding the meetings at the most convenient railway centres, it has been decided they shall be held in the cities of Leeds, Sheffield and Bradford in rotation.

Among the numerous subjects discussed at the last meeting were questions of Car Lighting under the Defence of the Realm Act; Fuel Deliveries; Increased Cost of Materials Used on Tramways, etc.

Mr. W. E. Nicholl, of the Scarborough Tramways, who recently resigned his position to join the British Electric Federation, was heartily congratulated. A vote of thanks to the hon. secretary, Mr. Harry England, for his services during the past ten years concluded the meeting.

British Electrical Mutual Aid Fund.—The Fourth "Record" of the operations of the British Electrical Federation Mutual Aid Fund has been issued from the Federation offices. Four more men have been reported "killed in action," which brings the total death roll up to thirteen. The fund has received contributions amounting to £5,619, and the grants made to the dependents of the men in the service, chiefly on the recommendations of the local committees, amount to £4,049.

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LIVERPOOL CORPORATION TRAMWAYS.

The annual report for the year 1914 by Mr. C. W. Mallins, general manager of Liverpool Corporation Tramways, has now been issued, and it shows that the undertaking during the year continued to be in a highly prosperous condition, though the net revenue was somewhat less than that for the year 1913.

The following shows the results in brief form:—

The Total Revenue for the year 1914 amounted to ..	£722,307
Operating Costs (including Rental of Leased Lines)	£473,678
Gross Profit	£248,629

The Gross Profit has been apportioned as follows:—

Interest	£50,082
Sinking Fund and Repayment of Loans	£63,726
Reserve, Renewal and Depreciation Account ..	£34,821
Contribution in aid of the General Rate	£100,000

The net profit for the year amounted to £134,822, a decrease of £19,342 as compared with 1913. This decrease is due to:—(*a*) Increase in rates and taxes of £11,000; (*b*) increase in the wages account of about £10,000 (including the allowance to dependents of employees who have joined H.M. Forces); (*c*) the supplying of 1¾ millions of free passes—representing a value of £8,232—to members of H.M. Forces. Although the profit was decreased, the contribution in relief of the rates is the same as last year.

The following figures are interesting in connection with the financial position of the tramway undertaking since it came into the hands of the Corporation, viz.:—

The total sum set apart for Sinking Fund and Redemption of Debt up to December 31, 1914, amounted to	£1,177,949 7 2
Reserve, Renewal and Depreciation .. .. (A considerable portion of this amount has been expended on the erection of certain buildings and on the renewal of the permanent way).	£800,623 14 1
Contribution in Relief of Rates	£572,898 19 7

In addition, the sum paid by the tramways since 1897 in rates and taxes amounts to £401,383 os. 8d.

The number of passengers carried, miles run, and traffic receipts for the year 1914, compared with 1913, are as follows:—

	1914.	1913.	Increase.
Passengers ..	145,656,374	144,085,927	1,570,447 or 1·1 %
Receipts ..	£684,026	£677,881	£6,145 ,, 0·9 %
Mileage ..	13,657,888	13,442,605	215,283 ,, 1·6 %

There was thus an increase in the traffic receipts of £6,145, notwithstanding the fact that the country was under war conditions for nearly five months.

The average earnings per car mile amounted to 12·02d., as against 12·10d. for 1913. This decrease is due to the issuing of free passes to members of His Majesty's Forces.

The traffic receipts and number of passengers carried for the first seven months of the year are the highest recorded in connection with the Liverpool Tramways, but the outbreak of war had a serious effect upon the traffic receipts. However, by the careful adjustment of the service to traffic needs, the loss in this respect has been reduced to a minimum. The receipts from January 4 to August 1 showed a progressive increase equivalent to 4 per cent., and, had this continued for the whole of the year, the receipts would have been improved by some £21,000, notwithstanding the fact that last year their Majesties the King and Queen visited Liverpool, and that an Industrial Exhibition was held for six months.

About 850 of the staff have been mobilised or enlisted in H.M. Forces since the outbreak of war, and, under a resolution of the City Council of September 2, 1914, it was decided to pay the difference between the wages of employees and the army allowance, which amounts to about £540 per week, or, approximately, £28,000 per annum.

Following a resolution of the City Council on April 1, the Tramways Committee appointed a Sub-Committee to wait upon the Mersey Docks and Harbour Board, in order to ascertain what facilities the Board would be prepared to grant for the transport of merchandise by tramways from the Liverpool Docks to various Lancashire towns. The Sub-Committee waited upon the Mersey Docks and Harbour Board on July 1 last, but the Board consider that the transport of merchandise by electric tramcar is, at present, impracticable.

Six additional motor omnibuses of the latest type, viz., two Tilling-Stevens, two Brush-Daimler, and two Straker-Squire, were delivered and placed in service in April and May last, and the Committee are trying the different types for the purpose of ascertaining which is the most suitable for operation in Liverpool. Three routes of omnibuses are now being operated, viz., Woolton—Calderstones, Aigburth—Old Swan, Walton—Seaforth. The total number of passengers carried during 1914 was 1,025,270, and the receipts amounted to £7,206.

The trial automatic point controllers installed in 1913 having proved satisfactory, the Committee, on February 13, 1914, decided to gradually equip the whole of the service with these point controllers, and 62 points have now been so equipped, and nearly the whole of the point attendants have been transferred to the car depôts. The change-over has resulted in considerable economy and convenience in operation, and has been effected without displacing a single employee.

An increased speed limit was granted by the Board of Trade on most of the routes, and the services have been arranged accordingly, with advantage to the travelling public.

The Tramways Committee took over their own third party risk on May 15, 1908, at which period they were paying to an insurance company the sum of £11,580 per annum. Since the Committee took over the business the amount paid in claims amounts to £29,611, or an average of £4,555 per annum, thus showing a saving during this period of £45.659, of which amount £30,000 has been placed in a Special Compensation Fund.

During the year the general overhauling of the rolling stock has been vigorously proceeded with. 100 cars have been equipped with the new 40-H.P. electrical equipments and have been thoroughly overhauled in every respect. In addition to this, another 100 cars were thoroughly overhauled, making a total of 200 cars dealt with. A considerable number of cars have also been painted and varnished, and the work of bringing the rolling stock into good condition is being pushed forward as rapidly as possible under the war conditions of labour. 16 new cars were completed and added to stock during the year, and an additional 11 cars are in hand.

The following statement shows the proportion of passengers for the various stages, viz.:

Value of Ticket.	Number sold.	Percentage of Total.
1d.	127,709,346	87·678
2d.	16,067,834	11·031
3d.	1,519,113	1·043
4d.	223,580	·154
5d.	5,190	·004
6d.	131,311	·090
	145,656,374	

The number of cars arriving at and leaving the Pierhead on the different routes in the busy season is 6,946 per day, South Castle Street 1,211, Old Haymarket 764, and Lime Street 124, representing a total of 9,045 cars running in and out of the city per day.

During 1914, 25 persons, who had been knocked down or had fallen in front of tramcars, were pushed clear by the Liverpool plough life-guard, without serious injury. In the same period 8 fatal accidents took place.

There were 2,370 members on the books of the Tramways Benefit Society on December 31, 1914, as compared with 2,248 the previous year, an increase of 122. The sum paid in sick allowance during 1914 amounted to £2,667 7s. 11d., which was granted for varying periods to 1,180 members, each receiving an average of £2 5s. 2½d. The number of separate claims was 4,350, an increase of 154 as compared with 1913. 42 death claims were paid, of which 30 were members and 12 members' wives, compared with 19 and 13 respectively during 1913. The total income for the year amounted to £4,839 13s. 3½d., and the expenditure, including £513 10s. transferred to Retirement Fund, to £4,645, leaving a balance of £194 13s. 3½d. The sum standing to the credit of the Society on December 31 amounted to £5,100, all of which is invested in Liverpool Corporation Bonds, bearing interest at 3½ per cent. The Retirement Fund which was inaugurated on July 1, 1908, by the transfer of £3,000 from the Benefit Society surplus funds, now amounts to upwards of £23,000.

The membership of the Social, Athletic and Thrift Society on December 31 stood at 2,007, an increase of 53 on 1913. The receipts on general account, together with the amounts brought forward from 1913, amounted to £2,897 18s. 11½d., and the payments to £2,236 14s. 2d. The branch receipts amounted to £1,930 6s. 3½d., and the payments to £1,853 os. 9½d., leaving a total cash balance of £738 10s. 3½d. The total sum granted by the Society to the Retirement Fund now amounts to £650. During the year a sum of £42 10s. was voted in compassionate allowances to members who had been incapacitated by sickness for a considerable period.

Analysis of the working expenses shows that they amounted to 8·238d. per car mile, compared with 7·977d. in 1913. Adding rent of leased lines, interest, and sinking fund payments, the total is 10·322d. per car mile against 10·015d. The car mile earnings were 12·02d., against 12·1d.

Tramway Wages in Germany.—Berlin tramwaymen work long hours for small pay. According to a Berlin newspaper, conductors are getting 3s. 6d. a day for ten to twelve hours' work. Owing to the difficulty of inducing men to work under those conditions, the tramway company cannot fill the vacancies caused by men being called into army service, and a number of lines have ceased running.

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METROPOLITAN DISTRICT RAILWAY.

Below will be found an abstract of the accounts of the Metropolitan District Railway for the past year, along with comparisons with the year 1913. The accounts are not in the complete form required by the Railway Accounts Act, as this railway like most others in the country has come under Government control since the war began, and accordingly certain accounts and returns are omitted under authority from the Board of Trade. The receipts for the year include an estimated and unspecified sum to be received from the Government. The London "tube" railways are not included under Government control nor guarantee, and hence their accounts are as full as usual. The chief matters which thus have to be omitted from the following abstract are details of working expenses, details of receipts, and number of passengers. In any event, however, the details of the accounts of the Metropolitan District Railway are more difficult to deal with in a clear analysis than those of the "tube" lines, as matters are complicated by the company running over lines jointly owned and jointly leased or worked, and the figures in most cases are not given separately. It will be seen, however, that the total net receipts are somewhat down, as expenses—partly no doubt owing to the war—have gone up by over £30,000. It is gratifying to note that the percentage of railway expenditure to railway receipts (excluding miscellaneous receipts) is only 50·6, which is a good showing for electric traction on somewhat complicated city and suburban routes. There is no electric power and lighting account, which is described as not applicable to the company. Presumably this is because the Chelsea power station supplies also the London Electric Railway, but the accounts of the company are similarly silent on the subject, so that we are without details of the working costs of the power station.

CAPITAL ACCOUNTS.

	1914.	1913.
	£	£
Capital created:—		
Shares and stock	10,109,166	10,109,166
Loans or debenture stock	3,586,374	3,586,374
Total	13,695,540	13,695,540
Capital created by some other company on which the company jointly or separately guarantees fixed dividends:—		
Loans or debenture stock	429,000	429,000
Capital issued:—		
Shares and stock	9,530,905	9,530,905
Nominal additions	576,508	576,508
Loans and debenture stock	3,520,411	3,520,411
Nominal additions	60,000	60,000
Total	13,687,824	13,687,824
Capital expended during year	117,400	100,621
Total capital expenditure to date	11,549,474	11,432,074
Capital receipts (including premiums and discounts)	11,381,720	11,381,720
Subscriptions to other companies	600,000	600,000
Capital expenditure per mile of single track owned and open (exclusive of sidings)	211,917	212,689
Estimate of further capital expenditure	70,000	153,550

REVENUE ACCOUNTS.

	1914.	1913.
	£	£
Gross railway receipts (including for 1914 estimated amount receivable under agreement with the Government)	817,456	789,662
Railway expenditure	413,970	383,132
Net railway receipts	403,486	406,530
Miscellaneous receipts (net)	115,735	116,542
Total net income	519,221	523,072
Net income, including balance forward	531,880	531,601
Deduct interest and other fixed charges	343,662	337,262
Balance	188,218	194,339
Appropriation to reserve for renewals	20,000	20,000
Dividends on guaranteed and preference stocks	154,330 (a)	161,680 (b)
Dividend on ordinary stock	Nil.	Nil.
Balance forward	13,888	12,659

(a) 4 per cent on guaranteed stock, 4½ per cent. on first preference stock, and 2 per cent. on second preference stock.

(b) 4 per cent. on guaranteed stock, 4½ per cent. on first preference stock, and 2½ per cent. on second preference stock.

STATISTICAL RETURNS.

	1914. Mls	1914. Chs.	1913. Mls.	1913. Chs.
Lines owned:—				
Length of route	25	42	25	34
Length reduced to single track	54	44	53	71
Sidings reduced to single track	12	20	11	71
Total single track including sidings	66	64	65	62
Lines leased or worked:—				
Length of route	2	11	2	11
Length reduced to single track	4	12	4	9
Sidings reduced to single track	0	13	0	15
Total single track including sidings	4	25	4	24
Length of route authorised but not open	0	45	1	13

	1914. Number.	1914. Carrying Capacity.	1913. Number.	1913. Carrying Capacity.
		Seats.		*Seats.*
Rolling Stock:				
Steam locomotives	2	—	2	—
Electric locomotives	6	—	6	—
Motor Cars	232	11,016	206	9,760
Trailer cars	222	10,656	218	10,464
Total	462	21,672	432	20,224

In addition to the above there are 64 railway service vehicles compared with 49 in 1913.

Train mileage (excluding empty trains run for traffic purposes), shunting miles, etc.	5,272,972
Ditto in 1913	5,278,361
Total train mileage of all kinds	5,424,435
Ditto in 1913	5,338,440

FINANCIAL REPORTS AND MEETINGS.

Brazilian Traction, Light, and Power Company.—Dividend of 1½ per cent. for the three months ending March 31 on the 6 per cent. preference shares.

Manila Electric Railroad.—The directors of the Manila Electric Railroad Company recommend a dividend for the quarter ending March 31 of 1½ per cent. on the ordinary shares.

Halley's Industrial Motors.—A final dividend at the rate of 30 per cent. on the old shares, making 20 per cent. for the year, and at the rate of 20 per cent. per annum on the new shares.

Deficit at Southampton.—The estimates of the Tramway Committee of Southampton Town Council show that, after contributing £5,143 to the borough funds, there is a deficit of £920.

Wolverhampton Rates Assisted.—The Town Council of Wolverhampton have resolved to transfer £2,215 from the profits of the Electrity Department, and £4,018 from the Tramways Committee's surplus, to the rates fund.

South Staffordshire Tramways Company, Ltd.—The accounts for 1914 show a disposable balance, including £603 brought forward, of £3,728. The directors recommend a dividend of 3½ per cent. on the preference shares, carrying forward £843.

Wemyss and District Tramway Company.—After adding £200 to the redemption fund and £1,250 to depreciation reserve, the profits for 1914 amounted to £4,859. A dividend of 7½ per cent. on the ordinary shares is proposed, carrying forward £1,580.

The Melbourne Tramway and Omnibus Company, Ltd.—The London Secretary has received cable advice from Melbourne of the declaration of a dividend of 6d. per share for the quarter ending March 31, and also a bonus of like amount making together 1s. per share payable on April 1.

Cammell Laird.—A final dividend of 5 per cent. is recommended on the ordinary shares, making 7½ per cent. for the year, while £100,000 is placed to reserve, and £25,937 is carried forward. A year ago a dividend of 2½ per cent. was paid, £50,000 was placed to reserve, and £37,000 was carried forward.

Brown Bayley's Steelworks.—The directors do not recommend a further dividend. The past year's distribution will be represented by the 5 per cent. (actual) paid on both classes of shares in July. The ordinary shares received 10 per cent. for 1913, 15 per cent. for 1912, and 12½ per cent. for each of the three preceding years.

Lucan Tramway Company.—The annual report of the Dublin and Lucan Electric Railway Company, presented to the meeting of shareholders, showed a gross income for the year of £7,357. After paying debenture interest and other charges, there remains a balance of £362, which is to be carried forward to next year's account.

Hastings and District Electric Trams.—In their report for the year ended December 31, 1914, the directors of the Hastings and District Electric Tramways Company recommend a dividend of 6 per cent. on the preference shares, the allocation of £1,000 to depreciation, £1,500 to reduction of suspense account, and £1,121 to be carried forward.

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Colchester Tramways Deficit.—The report of the Tramways Committee read at the meeting of Colchester Town Council, held on March 3, stated that the tramway manager and the borough accountant estimated that the approximate deficit for the current financial year would amount to £650, as compared with £2,333 for the previous year.

Jarrow and District Electric Traction Company.—The annual meeting of shareholders was held in London on March 1. Mr. H. S. Day, the chairman, expressed the view that the improvement which allowed of a 3½ per cent. dividend, compared with a 2½, was satisfactory, and there was reason to believe it would be at least maintained. The report was adopted.

Loss on Ilkeston Tramways.—The Tramways Committee of Ilkeston reported to the Town Council, at the meeting held on March 2, that the loss on the tramway undertaking for the year was £2,600, equal to a rate of 7d. in the pound. Commenting on the fact, the Mayor stated that during the twelve years the tramways had been in existence the ratepayers had been required to pay a bill for £33,199.

Madras Electric Tramways.—The gross profit for the year 1914 was £21,521. After deducting interest, London office expenses, allowance for debenture sinking fund, and £7,000 transferred to depreciation and renewals fund, there remains a balance which, including £3,320 brought forward, amounts to £12,621. A dividend of 5 per cent. on the ordinary shares has been paid.

Blackpool and Fleetwood Tramroad Company.—In moving adoption of the report of this company at the meeting, details of which were given in a previous issue, Mr. J. Greenwood stated that 25 per cent. of the company's employees had joined the Army, and regretted to say that two had been killed in action. During the year, £3,200 had been spent in the purchase of four covered cars. They had also extended the car shed to take in 12 cars, at a cost of £2,500.

Brush Electrical Engineering Company. The directors' report of the Brush Electrical Company states that, after providing for general charges, maintenance of buildings and plant, and interest on debenture stocks, there remains a balance of £19,109. The directors recommend that £10,000 be placed to a reserve account for depreciation, that £2,044 be applied in payment of the further 4 per cent. to which the holders of 6 per cent. prior lien participating second debenture stock are entitled, and that the balance of £7,065 be carried forward.

Walsall Tramways.—The annual report of the Tramways Committee of Walsall Town Council shows that the traffic revenue of the undertaking was £33,311, and the total revenue £34,089. Working expenses were £21,821. After paying interest on capital, allowance for sinking fund and the cost of alterations, there remains a net profit of £3,478. From that amount there falls to be deducted £1,000 as contribution to the borough fund on account of 1914, leaving a net surplus of £2,478. During the year the tramways carried 6,752,727 passengers, at a cost of 7.276d. per car mile.

Bath Electric Tramways.—The annual report of the directors of the Bath Electric Tramways Company states that, after charging expenses of working for the year ended December 31, 1914, there remains a balance of £16,132, which, with the amount carried forward from previous year, makes up a total of £16,993. After deducting interest on debentures, loans, etc., instalment of sinking fund, and dividend on first preference shares, a balance is left of £5,224, which the directors recommend should be carried forward, and used chiefly in replacing the motor fleet, which has been largely depleted by the requisitions of the Government for war purposes.

Hadfields Ltd.—The net profits for 1914 were £139,301, and £50,469 was brought forward. A final dividend of 10 per cent. and a bonus of 7½ per cent. are recommended, making 22½ per cent. for the year, adding £26,000 to the reserve and renewal fund, and carrying forward £60,270. The net profits were £109,512 for 1913, and £116,298 for 1912, and 20 per cent. was distributed for each year, sums of £15,000 and £20,000 being reserved on the respective occasions. The surplus at the end of 1912 was £49,455. Net earnings were £79,417 for 1911, and £69,955 for 1910, and the dividends for each period amounted to 17½ per cent., sums of £46,757 and £33,280 remaining.

Bournemouth Corporation Tramways.—The Tramways Committee of Bournemouth Town Council submitted the estimates for the year to the monthly meeting of the Council held on March 3. The estimated revenue for the year is £102,750, and the expenditure, including working expenses and capital charges, amounts to £95,141, showing a net surplus of £7,609. Working expenses were £56,800, capital charges, including £1,684 for ten new cars and permanent way reconstruction, amounted to £34,941; allowances to employees on military service took £2,400. There are 150 employees with the colours, entailing an expense to the Tramways Committee of about £80 per week.

British Aluminium Company.—The accounts for the year 1914 show that the profit, together with interest on investments and revenue from Kinlochleven and Foyers estates and transfer fee, is £272,256. Addition of £16,690 brought forward makes a sum of £288,946 available for appropriation. Allocation has been made as follows: Provision for income-tax, legal expenses, bad and doubtful debts, depreciation of investments, and proportion of profits payable to directors, £24,965; prior lien debenture service fund, £48,000; reserve for depreciations, £50,000; to reserve account, £50,000. After paying the preference dividend, the directors are able to recommend a dividend of 5 per cent. on the ordinary shares, leaving £24,751 to be carried forward. Reserve account will now stand at £180,000, and depreciation reserve account at £200,000.

Para Electric Railways.—The general meeting of the Para Electric Railways and Lighting Company was held in London, Mr. Follett Holt, chairman of the company, presiding. The chairman, in moving the adoption of the directors' report, pointed out that there was a reduction in gross receipts of £50,000. Against that loss they were able to set a reduction of £32,000 in expenses, without any sacrifice in the upkeep of the property or of efficiency in the service. The directors had decided to add £25,000 to the reserve funds, bringing up the total to £132,000. Adding the amount they proposed carrying forward, the company had a total accumulation of £152,000 In view of all circumstances, the directors had no hesitation in asking the shareholders to confirm the reduction from 10 per cent. to 6 per cent. in dividend on the ordinary shares.

W. T. Henley's Telegraph Works Company. The net profits for 1914 were £90,125, after providing for debenture interest, and £59,065 was brought forward. A final dividend on the ordinary shares of 10 per cent., less income tax, making 15 per cent. for the year, and also a bonus of 5s. per share, are recommended, adding £30,000 to the reserve funds, and leaving to be carried forward £69,419. The net profits for 1913 were £85,665, and the distribution was similar to that proposed for the past year, £20,284 being set aside. Mr. Sidney Gedge, presiding at the meeting in London on March 19, said that, apart from the war demand, the business had grown, the turnover during the past year having been the largest they had ever had. They were able to pay a dividend of 15 per cent. and a bonus of 5 per cent. The trading profits were £7,000 more than in the previous year, amounting to £119,245 They were carrying forward £10,000 more. Prospects for the current year were good. They had sufficient orders on the books at the present time to pay a dividend. The report was adopted.

South Metropolitan Electric Tramways and Lighting Company.—The total revenue for the year 1914 from all sources amounted to £105,323, compared with £103,135 for the preceding year After adding the balance brought forward and deducting all expenses chargeable to revenue, and after setting aside the sum of £3,000 to renewals fund, there remains a surplus of £16,721, which the directors recommend should be appropriated as follows:—To be placed to reserve, £4,500; to payment of a dividend at the rate of 6 per cent. per annum on the preference shares for the year to December 31, 1913, £10,174; to payment on account of preference dividend for the year 1914, at the rate of 1 per cent., £1,695; to be carried forward, £351. The gross receipts derived from the working of the tramways and light railways amounted to £45,265, being a decrease of £177 as compared with the previous year. The net receipts from the company's motor omnibuses amounted to £2,387. The gross receipts from the electricity supply section of the undertaking (including the amount represented by the sale of energy to the tramways) amounted to £16,441, as compared with £15,694 for 1913.

Stewarts and Lloyds.—The report for the year 1914 shows that after providing for debenture interest and adding £100,000 to the depreciation fund the net profit amounts to £233,420. The sum of £95,371 was brought forward from the previous year. It is proposed to pay a final dividend of 2s. per share on the deferred shares, making 2s. 6d. per share (12½ per cent.), free of income-tax, for the year, to add £50,000 to the reserve and £10,000 to the employees' benefit fund, and to carry forward £97,666. The net profits and the dividends on the deferred shares, after making additions to the depreciation fund, for the past five years, are shown in the table following:—

	Net Profits.	Added to reserves.	Dividends Per annum.	Carried forward.
1914	£233,420	£60,000	12½ per cent.	£97,666
1913	246,065	70,000	12½ ,, ,,	95,371
1912	266,896	47,817	10 ,, ,,	90,431
1911	202,133	70,000	5 ,, ,,	86,539
1910	162,647	32,156	5 ,, ,,	83,030

A year ago and in 1912 sums of £100,000 were added to the depreciation fund and £70,000 in each of preceding years.

London United Tramways.—The gross receipts of this company for the year ended December 31 amounted to £327,871. After adding the balance brought forward from 1913 and deducting all expenses chargeable to revenue, including £12,500 to reserve for reconstruction and renewals, there is a balance of £8,142. The directors recommend that a dividend on the preference shares of one-half per cent., requiring £6,250, be paid and the balance of £1,892 carried forward. The traffic receipts amounted to £316,838, showing a decrease of £11,768 as compared with the previous year. This decrease is due to the conditions which have prevailed since the outbreak of war in August last. Owing to the number of employees who, as reservists, were recalled to

(*Continued on page 281.*)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ...	*May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington ...	*Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne..	*Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1914	Sept.. 1901	,,	9 30	...	...	...	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ...	*Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ..	*Mar. 25. 1914	Mar., 1899	,,	24 63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool ..	*Mar. 31. 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14.524	310,994	126,036	21,660	84,034	763	84,797
Bolton	*Mar. 31, 1914	Dec.. 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford ..	*Mar. 31. 1914	July, 1898	,,	(h)106 29	1,280,788	1,061.113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18.608	317,133
Brighton	*Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100.188	278,467	16,202	219,972	62,273	5,841	54,600	2.238	56,838
Burnley	*Mar. 31, 1914	Dec.. 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	*Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1914	June, 1903	,,	21 2 (b)13 21	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l)29,518	69,745	335	70,080
Chester	*Mar. 25, 1914	April. 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ..	*Mar. 31, 1914	Dec.. 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ...	*Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	*Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington ..	*Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30.892	8.500	15,631	1,003	16,634
Derby	*Mar. 31. 1914	July, 1904	E.	22 20	...	...	...	245,332	11,026	177,676	67,656	(l)32,356	E51,126	1,048	52,174
			H.	...	...	...	...	...	...	...	...	...	H 429	19	448
Doncaster ..	*Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham ..	*Mar. 31. 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	*Mar. 31. 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ...	*Mar 31. 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	*Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	*Mar. 31. 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	*Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	*Mar. 31. 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley ...	Mar. 31. 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,156
Kilmarnock ..	*May 15. 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ...	*May 15, 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster ...	*Mar. 31. 1914	Jan.. 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	*May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	*Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool ...	*Dec. 31, 1914	Nov., 1898	,,	124 0	...	...	...	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ..	*Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ..	*Mar. 31. 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ..	*Mar. 31. 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1.616,131	491,410	478,381	911,223	14,087	925,310
Nelson	*Mar. 31. 1914	Feb.. 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.).	*Mar. 31. 1914	April. 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ..	*Mar. 31, 1914	Jan., 1901	,,	...	...	...	...	667,705	...	410,091	237.501	68,372	172,731	2,648	175,379
Oldham	*Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov.. 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth ..	*Mar. 31, 1914	Sept., 1899	,,	15 0	...	...	...	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ...	Mar. 31. 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall ...	*Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale ...	*Mar. 31, 1914	May. 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham ..	*Mar. 31, 1914	Jan., 1903	,,	12 2	...	183,775	...	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	*Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ...	*Mar. 31, 1914	Jan.. 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31. 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ..	*Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ...	*Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l)26,881	37,744	586	38,330
Staly'ge, H., E., D.	*Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport ..	*Mar. 31, 1914	Aug., 1901	,,	27 5	...	...	...	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	*Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey ...	*Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3.577	216.498	10.848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1913	Dec.. 1902	,,	19 44	188,145	188,100	45	183,351	9,378	159,561	58,366	33,873	32,991	682	33,673
Walthamstow ...	*Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington ...	*Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10.583	70,476	32,422	10,000	23,232	521	23,753
West Ham ..	*Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	*Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	*Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)..	*Mar. 31, 1914	June. 1902	E.	14 58	149.600	124,750	24,850	126,363	9.207	116,450	25,996	9,075	25,712	527	26,239
York	*Mar. 31. 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1914	Nov., 1905	E.	98 54	1.528.146	1,381,200	146,946	1.440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	*Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead ..	*Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	*Mar. 31, 1914	July, 1902	,,	(e) 29 62	432,440	...	...	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	*Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43.090	786,510	24,714	514.059	273,232	104,002	141,519	24,681	166,200
Coventry ...	*Mar. 31. 1914	Jan.. 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1914	Oct., 1898	,,	193 40 (h) 2 53	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
Huddersfield ...	*Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	*Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	*Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3.939	427,455
Leicester... ...	*Dec. 31. 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	*Mar. 31, 1914	...	H.	13 73	...	...	...	...	...	...	...	...	21,145	480	21,625
		May, 1903	C E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65.698	2,247,042
N'castle-on-Tyne	*Mar. 31. 1914	Dec., 1901	,,	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ..	*Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40.501	11,834	28,527	812	29,339
Portsmouth ...	*Mar 31. 1914	Sep.. 1901	,,	34 51	708,618	708.618	...	772,684	22,308	449,206	259.413	75,054	115,166	1,823	116,991
Preston	*Mar. 31. 1914	June, 1904	,,	17 16	224,102	187,269	36.833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1914	July, 1903	,,	13 14	235,000	234.000	1,000	230,763	17,515	162,634	68.159	18.371	35,282	1,043	36,325
Sheffield	*Mar 25. 1914	Sep.. 1899	,,	79 3	1,640,371	1,426.217	214,154	1,521.439	19,250	1,073.612	463.575	30.378	386.114	3.562	389,676
Wellington, N.Z.	*Mar. 31. 1914	...	...	31 55	496.423	496.423	...	628.151	19.821	496.423	46.836	120.191	157.096	1,161	158.257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Additional lines leased and worked. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1¼ miles railless trolley route. (i) 17 mi. 8 chs. single track leased.
(k) Not including 10 miles 8 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses. Traffic.	General.	Repairs & Maintenance.	Power.	Total.	Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit. Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	Net Surplus + or Deficit −
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-und-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	(h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	35,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,306	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	...	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,000
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 358
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1, 310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,291	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,019	3,201	4,678	5,710	21,608	12,065	1,371	5,191	3,439	458	1,868	...	10,956	+ 2,480
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(c) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,005
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10 806 E 809,987	3,679 (r) 183,797	4,059 345,138	(m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,836
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,608
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	..	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	− 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 18,431

(a) Includes £11,374 balance forward from previous year.
(b) Includes £311 loss on omnibus account.
(c) Includes £1,611 insurance fund.
(d) Includes reserve.
(e) Includes rents for leased lines.
(f) Rent of leased lines.
(g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax.
(j) Includes £612 deficit on railless traction.
(k) Includes rents of lines.
(l) Including loss on horse traction.
(m) Horsing expenses.
(n) Transferred to motor omnibus capital account
(o) Includes £1,337 through-running contributions.
(p) Includes £407 horse account.
(r) Including special charges, £6,063.
(s) Includes £2,584 through-running contributions to L.C.C.
(w) Amount apportioned to leased lines.
(x) Includes £365 profit motor char-a-banc.
(z) Includes £6,519 rent of leased lines.
‡ £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Costs).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile. d.	Average Traffic per Car Mile. d.	Traffic. d.	General. d.	Repairs and Maintenance. d.	Power. (Price paid) d.	Total. d.	%	d.	Units.	Cost per Unit. d.	Units used per car mile.
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	610,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421 844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,825	1·125	1·70
Blackburn ...	4,011	...	...	14·08	13·46	3·41	·97	2·93	2·06	9·37	66·10	7·37	1,901.668	1·3	1·64
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·38	10·26	2·315	·769	1·213	1·252	5·549	50·44	4·297	2,037,620	1	1·252
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	448	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E 10·358	10·150	3·438	·577	1·092	1·709	6·816	65·8	5·107	1,425,112	1·45	1·179
				H. 6·077	5·821	7·325	...	1·099	...	8·424	138·6	...	...	...	...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	..	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	7,013	24,000	...	11·87	3·04	1·04	1·34	1·92	7·34	61·82	5·42	5,359,804	1·25	1·51
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ...	4,287	750	12·54	12·52	2·92	·87	2·22	2·79	8·80	70·15	6·01	1,731,184	1·375	2·03
	R.T....	1,009	...	10·74	10·74	2·44	·76	2·68	1·23	7·11	66·20	5·88	120,303	1·375	1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport ...		250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	1,480	...	1,000	11·234	11·007	2·675	1·068	1·561	1·905	7·209	64	5·304	845 654	1·68	1·176
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1 5/8	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21	8·94	3·32	·76	1·41	1·01	6·50	70·55	5·49	154,048,461	·601	2·63
				H. 8·15	7·97	4·07	1·39	1·53	4·40	11·39	139·72	11·39	...	...	...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30.581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	..	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Traffic Records. Car Mileage.	Passengers Carried.	Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Popular'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		d.	Miles.	d.	Miles.			
Aberdeen	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10/3	·508	1·80	·88	7·5	703	54	77
Accrington	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13·1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr ...	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11·1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,244	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn	200,000	1,149,462	12,731,532	11·07	1·28	63·15	105	2,751	6/10	·88	1·26	·76	7·5	448	32	61
Blackpool	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24/9	·73	..	...	8	...	34	78
Bolton	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6/3	·91	1·505	·58	7·5	...	...	20
Bury ...	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10 10	·543	1·24	·85	8·51	483·83	45·26	54
Chester	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5 5	·78	1·38	·75	7·33	126	7	17
Colchester	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4/8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9/10	·871	2 05	·50	8·14	942·23	59	75
Darlington	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·46	6·66	151·25	11	18
Darwen	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	..	...	...	...	...	...
Derby	124,000	E 1,208,880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935		...	...	...	1·35	1	1	..	...	..	3
Doncaster	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8 2	·547	2	·50	7·3	...	...	68
East Ham	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax	176,000	2,242,085	20,276,077	9·04	1·26	115	80·21	1,958	12/4	·867	1·30	·87	7·23	853·93	77	101
Ilford	84,000	899,816	8,036,552	9·70	·758	95·7	...	2,256	5/7	·62	1·543	·69	8	...	..	26
Ilkeston	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52 8	·8	1·50	·6	7	101	7	13
Ipswich	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	185	17	22
Lancaster	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6,11	·532	1·75	·428	7	90	5	8
Liverpool	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,010	420	596
Lowestoft	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	..	...		662
Nelson	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	6·50	108	6	11
Newport	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,543,669	40,535,874	11·43	1·02	155	92·72	..	13/2	·642	1·70	1	6·86	...	105	135
Oldham	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	..	...	6·25	120	8	12
Plymouth	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639		...	...	...	...	42
Pontypridd	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·61	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10/9	·751	1·12	·88	9	247·5	15	24
Rochdale	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham	64,000	E 852,639	9,874,231	11·58	1·08	154·3	...	3,701	13,9	·76	...	...	...	...	...	...
	...	H T 128,685	471,690	3·67	2·72	...	...	...	...	1·92	..	...	...	...	...	...
Salford	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543 941	13,162,224	8·52	1·23	108	77·38	3,624	11/1	·82	1·25	·55	...	...		70
Southend	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·68	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6·9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	...	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall	100,000	719,372	6,121,381	8·509	1·293	61	86	1,885	6/7	·847	1·24	·79	7	345	23	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·66	7·5	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9·7	·73	1·80	·51	7·75	1,235	95	118
Wigan	200,000	1,500,846	14,235,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·28	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17·5	·824	1·19	·87	6·8	1,140	60	81
Cardiff	182,729	2,966 230	31,122,962	10·49	1·09	170	98·5	4,447	15 6	·65	1·44	·736	7·5	1,264	79	130
Coventry	135,000	1,125,703	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds	525,000	9,204,331	93,673,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451		160
London	...	E 38,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·05	17.728·8	1,335	1,722
		H 636,933	613,781	10·38	·77	...	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6·4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7·7	·764	1·01	·95	7·36	404·7	21·3	33
Reading	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16·1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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the colours, it was found necessary to reduce the services, and further reductions had subsequently to be made owing to the enlistment of employees in the new armies. The number of men at present serving with the Forces is no fewer than 381, equivalent to about 24 per cent. of the entire staff. During the year a considerable length of track has been reconstructed, and £29,439 has been charged to the reserve for reconstruction and renewals. The mileage open is 53·5, and the company now has 338 cars. The number of passengers carried was 61,433,783, and the car miles run were 8,996,891. The average receipts per car mile were 8·47d., a decrease of ·08d. Mr. W. M. Ackworth, presiding on March 26 at the meeting of this company, said in regard to the revenue account, after allowing for the appropriation to reserve for reconstruction and renewals there remained a balance of £8,142. The traffic receipts amounted to £316,838, a decrease of over £11,700. The car mileage run was some 410,000 miles less than in 1913. Up to the beginning of August the passenger receipts were £2,243 in excess of those of the corresponding period for 1913; but by the end of the year that increase had been turned into a decrease of £11,793. Apart from the reduced services, the receipts decreased owing to the earlier closing of publichouses, and the restricted street lighting.

London and Suburban Traction Company.—The ordinary general meeting was held on Friday, March 26. The Right Hon. Stuart Wortley, K.C., M.P., presided, and said that the total traffic receipts on the traction and omnibus companies in which they had interest during the last year were £1,303,912, against £1,152,494 in 1913. The passengers carried were 246,831,117 against 218,900,648 in 1913. With regard to the supplies of electric current, 39,510,388 units were sold, against 36,904,469 in 1913. The total income from their holdings in the subsidiary companies was £107,884, plus £10,593 for interest on money lent to those companies. These figures compared with £98,925 and £6,309 respectively for the year before. Including this payment to sinking fund, the total expenses amounted to £34,953 against £17,118 for 1913. The result was that they had been able to find £80,110 for full dividend at 5 per cent. on the preference shares, as well as £9,226 for a dividend on the ordinary shares for the first half only of the year at the rate of 1 per cent. per annum, finally carrying forward £2,886, against £8,597 in the previous year. In the first half of 1914 they had a fair prospect of realising the hopeful anticipation in which he indulged when he spoke last year. It was in the early days of July that their interim dividends were declared. The effect of the war on the company's business had undoubtedly been adverse, but it might very well have been worse. What would be the company's experience during the remainder of the war no one could say, but he thought that they were well justified in hoping that peace would bring a return to them of at least the modest prosperity that the first half of 1914 seemed to promise.

Metropolitan Electric Tramways, Limited.—The revenue for the year amounted to £531,587, and after adding the balance brought forward from 1913 and deducting all expenses chargeable to revenue, there remains an available balance of £47,604. The directors recommend that this sum shall be allocated as follows:—To reserve account, £12,000; preference shares dividend, £25,000; ordinary share dividend at 2 per cent., £9,486, leaving £1,118 to be carried forward. Traffic receipts amounted to £467,414, showing a decrease of £8,510 as compared with the previous year. This decrease is due to the conditions which have prevailed since the outbreak of war. Owing to the number of employees who, as reservists, were recalled to the colours, it was found necessary to reduce the services in August last. Further reductions had subsequently to be made, owing to the enlistment of employees in the new armies. At the present time 484 employees, equivalent to about 25 per cent. of the total staff, are serving in the army or navy. The business of the North Metropolitan Electric Power Supply Company, in spite of the decrease in a number of units supplied for traction purposes during the last five months of the year, has been satisfactorily maintained; the total number of units sold during 1914 amounted to 36,869,118, an increase of approximately 7 per cent. over the figures for the preceding year. The number of passengers carried was 93,325,170, and the car-mileage 11,479,592. The average receipts per car-mile amounted to 9·77d., an increase of ·46d. The company now has 312 cars, and the track-mileage remains as last year—viz., 56·25 miles.

Mr. O. W. Brain, M.I.E.E., chief electrical engineer for railways and tramways, N.S.W. Government, has accepted the position of president of the Electrical Association of Australia. Other officers are:—Vice-Presidents, W. H. Alabaster, chief assistant electrical engineer, Melbourne City Council; W. H. Myers, assistant engineer, Electrical Branch, N.S.W. Government Railways and Tramways (president of the New South Wales Section); members of Council:—Prof. Henry Payne (Melbourne University, engineering department), Mr. W. J. Newbiggin (director, Adams and Company, Melbourne), Mr. H. R. Forbes-Mackay (city electrical engineer, Sydney), Mr. A. C. F. Webb, M.I.E.E. (consulting electrical engineer, Sydney).—*Sydney Morning Herald.*

THE BRITISH WESTINGHOUSE COMPANY.

AN ENCOURAGING YEAR.

The 15th annual meeting of the British Westinghouse Electric and Manufacturing Company, Ltd., was held on March 29, at Hamilton House, London, E.C. Mr. J. Annan Bryce, M.P., chairman of the company, addressing the shareholders, said that the net profit had been about £45,000 more than in 1913, and that this excellent result was caused mainly by increased efficiency. The profit of the year was almost entirely derived from contracts entered into before the war, and they had already suffered, and were likely to suffer still more, from the war, though its injurious effects were not apparent in the accounts of 1914. If they had divided the profits right up to the hilt the amount would have allowed a distribution of 15 per cent. on the capital, but they proposed to continue the policy of strengthening their resources by building up reserves. They had accordingly added £50,000 to general reserve, written £25,000 off goodwill, and carried forward a rather larger sum than last year. The sudden outburst of war in the beginning of August disturbed their industry; but the stoppage of business with Germany began to make itself felt, and orders were received in replacement of cancelled German contracts. At the same time the War Office and Admiralty placed contracts with them. Owing to these causes the volume of orders finished up at December 31 was only 17 per cent. behind that of 1913. They considered the acquisition of their American friends' interests in the French and Italian Westinghouse Companies a good bargain.

The 15th annual report of the company covered the year ended December 31, 1914. The directors state that, notwithstanding the abnormal conditions arising out of the state of war, the accounts showed continued improvement. The net profit for the year amounted to £151,627, which compares with £106,493 in the previous year. Including the balance brought forward of £6,493, there was a total sum for appropriation of £158,121. The directors recommended that this should be dealt with as follows:—General reserve, £50,000; to be written of patents, goodwill, etc., £25,000; dividend on preference shares at 7½ per cent., £75,000; balance carried forward. £8,121. Substantial sums have again been charged against revenue for the maintenance of works and plant, and in addition the sum of £50,846 has been applied to depreciation. Since the end of the year the company has acquired from the American Westinghouse Company their interests in the French, and, through it, in the Italian Westinghouse Companies. Mr. Alex Spencer, a director of Messrs. George Spencer, Moulton & Co., and vice-chairman of the Metropolitan Carriage, Wagon and Finance Company, Ltd., has been elected a director.

NOTICES.

Messrs. Estler Brothers have temporarily closed their office at Dowgate Hill, E.C., and their sole office in London is now at South Molton Road, Victoria Docks, E.

Clough, Smith and Company, Limited, have taken new premises at Regent House, Kingsway, London, W.C., to which address all communications should be sent. Their telegraphic address is "Clufmit Westcent, London," and their telephone number "Gerrard 3288."

The Peckham Truck and Engineering Company, Limited, have removed their offices from Queen Anne's Chambers to St. James's Park Chambers, 32, Broadway, Westminster, S.W. Their telegraphic address is "Truxenpeck, London," and their telephone number "Victoria 6565."

The Tramways and Light Railways Association.—As at present arranged, the Annual Dinner of this Association will be held in June. The exact date will be announced later. Through a misunderstanding, it was stated in our issue of March 11 that the dinner had been postponed, but the Council hope that members will have the opportunity of meeting informally in June.

Proceedings of the Municipal Tramways Association.—The annual report of the Municipal Tramways Association has now been published, and copies can be obtained at the price 5s. each on application to the hon. secretary (Mr. C. J. Spencer), at 5 and 7, Hall Ings, Bradford. The report is of much interest, and contains, among other valuable matter, the papers read before the managers' section, together with an extensive digest and analysis of private Acts passed during sessions 1913-14, in respect of Railless Traction and Motor Omnibus Legislation, which will be found extremely useful for reference. Local authorities and others desirous of obtaining copies of this report are advised to make early application.

Paper Money Note Holder.—The Peacock Brake Company, 27, Clements' Lane, London, E.C., have sent to us a very ingenious and convenient folder for keeping £1 and 10s. notes in such a way that they are readily accessible and apart from the usual contents of a pocket book. Notes of each denomination have merely to be laid on the respective sides of the holder and they are then by a slight manipulation firmly secured. How this is done readers may be left to discover for themselves.

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CONTRACTS AND ORDERS.

The British Westinghouse Company have an order from Barrow Town Council for a 200-K V.A. transformer.

Leeds Tramways and Electricity Committee has accepted the tender of the British Westinghouse Company for switchgear.

The Davenport Engineering Company have an order for a new cooling tower for the Blackpool electricity works.

Blessington Steam Tramway Company, of Dublin, has ordered two petrol electric cars to be used during the season of summer traffic.

Prahan and Malvern Tramway Trust, Victoria, has placed an order with Noyes Pty., Limited, for a booster and switchgear at £920.

Dick, Kerr and Company, Limited, have an order from Dover Tramways Committee for the supply of 50 tons of rails and the necessary fishplates.

The Albion Motor Car Company, Limited, have received an order from the Burmah Railway Company for a 15-H.P. 15-cwts. Albion box van.

Darlington Town Council has accepted the tender of Messrs. Fraser and Chalmers, of Erith, for a 3,000-KW. turbine and Siemens alternator.

The Macintosh Cable Company, Limited, have been selected as contractors to Ayr Corporation for the supply of cables, amounting to £9,624.

Chamberlain and Hookham, Limited, have a contract for the supply of tramcar meters for one year to Manchester Corporation Tramways.

The United Electric Car Company's tender for vestibules, staircases, etc., for 18 cars has been accepted by the Wolverhampton Tramways Committee.

Jas. Smith and Company (Derby), Limited, have an order for uniforms from Aberdare Urban District Council Tramways and Electricity Department.

The Glasgow Numerical Ticket and Check Book Printing Company have an order for tramway tickets for Aberdare Urban District Council Tramways.

Maidstone Town Council has accepted the tender of the Brush Electrical Engineering Company for a 1,250-KW. turbo-alternator of the Ljungstrom type, at £6,887.

W. A. Stevens, Limited, of Maidstone, have an order from Walsall Corporation for four double-deck and two single-deck petrol-electric omnibuses at £5,545 16s.

The British Westinghouse Company, Limited, have arranged a contract with the Melbourne City Council for a 5,000 KW. turbo-alternator at £15,111, and spare parts, £1,015.

Shrewsbury and Challiner, Limited, have secured contracts for tires for the Metropolitan Asylums Board and for the motor omnibuses of the Manchester Corporation Tramways.

Manchester Tramways Committee has accepted the tender of the British Insulated and Helsby Cables, Limited, for the supply of rail bonds, and of Hadfields Limited, for steel portable track rails.

Siemens Brothers Dynamo Works, Limited, have received an acceptance of their tender for the supply of carbon and metal filament lamps from the Colchester Corporation Tramways for the ensuing 12 months.

Siemens Brothers Dynamo Works, Limited, have again secured the contract for the annual supply of Wotan, Tantalum and Carbon filament lamps to the Salford Corporation Tramways Department.

The British Thomson-Houston Company, Limited, have been selected by Dover Corporation as contractors for the supply of a 1,000-KW. turbo-alternator set complete with exciter, condenser, and pumps, at £4,725.

Babcock and Wilcox, Limited, are to supply a boiler, superheater and economiser at £4,215, two chain-grate stokers, a motor-driven induced-draught plant with iron chimney, and an indicating steam flow meter to Croydon Town Council.

The Titan Trackwork Company, Limited, of Sheffield, have received a large contract from the Melbourne, Brunswick and Coburg Tramways Trust for turnouts, crossovers, and car shed layout in their "Titan" manganese steel.

York Electricity and Tramways Committee has accepted the tender of the Brush Electrical and Engineering Company for six double-deck cars at a price of £507 10s. each; also the tender of the British Thomson-Houston Company, Limited, for the electrical equipment of these cars at £304 each.

Croydon Borough Council has accepted the tender of Callender's Cable and Construction Company, Limited, for the supply of electric cables for the year to March 31, 1916. This is subject to a clause providing for payment on a sliding scale based upon the price of copper, which was reported to be about £70 per ton.

West Ham Corporation have accepted the following tenders as follows:—Bodies and trucks for 15 new tramcars, Brush Electrical Engineering Company, Loughborough; electrical equipment for 15 new tramcars, British Thomson-Houston Company, Rugby; controllers for the same, British Westinghouse Electric and Manufacturing Company, Trafford Park.

E. Bennis and Company, Limited, have received a repeat order from Coventry Electricity Department for eight chain grate stokers, 7 ft. by 13 ft. 6 in. centres, for Babcock and Wilcox boilers. Messrs. Bennis have also a repeat order from Manchester Electricity Department for re-linking with Bennis patent chain grate links two pairs of chain grates of another type at the Bloom Street power station.

Port Elizabeth (S.A.) Corporation have made the following contracts:—1,000 KW. turbo-alternator (turbo, Fraser and Chalmers, Limited; alternator, Dick, Kerr), 6,600 volts, three-phase, 50 periods; switchboard, British Thomson-Houston Company, Limited; motor converters, Bruce Peebles and Company, Limited: marine type water-tube boilers and coal conveyor and bunkers, Babcock and Wilcox, Limited.

Siemens Brothers Dynamo Works, Limited, have received an acceptance of their tender for the supply of carbon filament lamps from the London County Council for the ensuing 12 months. Messrs. Siemens Brothers have also obtained a contract for the supply of Wotan lamps, Wotan half-watt and carbon filament lamps from the Aberdare Council for the ensuing 12 months, and for Wotan and tantalum lamps for Middlesbrough Corporation.

Messrs. A. and F. Manuelle's tender for the supply of Guernsey granite setts during the next 12 months has been accepted by the London County Council. The prices were as follows:—3,000 tons 3 in. by 6 in., 40s.; 1,000 tons 3 in. by 6 in., 43s. 6d.; 1,250 tons 3 in. by 6 in., 40s.; 1,500 tons 3 in. by 6 in., 40s.; 500 tons 4 in. by 6 in., 37s. The total net value of the tender was £15,802 10s. Half the quantities tendered for will be taken, and the delivery will be spread over a period of six months, instead of 12 months.

Cancelled German Contract.—The *Times* reports that some 18 months ago the Lambton and Hetton Collieries, Limited, of Newcastle-on-Tyne, decided to increase the efficiency of the Philadelphia power station, near Sunderland, and a contract for three turbines was entrusted to the Allgemeine Elektricitats-Gesellschaft, of Berlin. The contract has been cancelled and the order has now been diverted to British engineers and divided among Messrs. James Howden and Company, Limited, Glasgow; Messrs. W. H. Allen, Son and Company, Limited, Bedford; and Messrs. Siemens Brothers Dynamo Works, Limited.

"Vaughan" Rail Anchors.—The Railway Track Supply Company, 80, Gracechurch Street, London, E.C., inform us that they have just concluded arrangements with their agents, Messrs. Elder, Smith and Company, to manufacture the "Vaughan" rail anchor locally in Melbourne, to supply the Victorian Government Railways requirements. As a preliminary, an order has just been placed for 10,000 "Vaughan" rail anchors. This is another instance of encouraging home manufacturing in Australia. Recently, it will be remembered, it was reported that steel rails were being made locally for the South Australian Government Railways at Broken Hill.

London County Council have accepted the tender of Dick, Kerr and Company, Limited, for the roadwork and platelaying in connection with the reconstruction on the overhead system of electric traction of the tramways in Grove Road, Burdett Road, etc. The following tenders were received:

Dick, Kerr and Company, Limited (recommended for acceptance)	£60,566 9 5
W. Manders and Company	61,052 7 2
A. N. Coles, Limited	62,195 3 2
J. Mowlem and Company, Limited	63,041 16 11
J. G. White and Company, Limited	63,818 15 8
A. Stark and Sons, Limited	63,903 11 11
G. J. Anderson	64,337 19 3
W. Griffiths and Company, Limited	64,575 1 8
G. Wimpey and Company	66,514 4 0

Liverpool Tramways Annual Supplies.—The following tenders have been accepted for annual supplies to the tramways department:—Dick, Kerr and Company, Limited, motor equipments; British Hele-Shaw Patent Clutch Company, steel gears and pinions; Miller and Company, Moston Malleable Castings Company, and E. Wilson and Company, iron castings; L. Andrew and Company, Avon India Rubber Company, Hellewell and Company, North British Rubber Company, and New Liverpool Rubber Company, rubber goods, etc.; Baxendale and Company, Charles Booth and Company, W. B. Brown and Company (Blankhall), D. H. Collins and Sons, Ambrose F. Flere, Guest, Keen and Nettlefolds, G. K. Harley, D. Laybourn and Company, Marsh Brothers and Company, Fred Moore and Company, Perrin, Hughes and Company, Chas. Richards and Sons, Rowe Brothers and Company, ironmongery, etc.; D. H. Collins and Sons, D. Laybourn and Company, and S. Peace and Sons, steel, wrought iron and files; Vacuum Oil Company, M. Wells and Company, lubricating oils and greases.

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PERSONAL.

Mr. R. P. Wilson is now returning to London after a long visit to South America.

Mr. Fraser, of Kilmarnock, has been appointed tramway traffic manager of Darlington Corporation Tramways.

Mr. George Richardson has resigned his seat on the board of Metropolitan Tramways, Limited, on account of ill-health.

Mr. David Willock has been elected to a seat on the board of the Electric Construction Company, rendered vacant by the death of Mr. William Bulloch.

Mr George Balfour, of Balfour, Beatty and Company, Limited, has joined the Board of the Cordoba Light, Power and Traction Company, Limited.

Mr. T. P. Collinge, borough surveyor of Mansfield, has been appointed borough surveyor of Rotherham, at a salary of £500 rising to £700 per annum.

Mr. H. M. Taylor, borough electrical engineer of Middlesbrough, has been granted leave of absence by the Electricity Committee to join His Majesty's forces.

Mr. Max Muspratt has been congratulated by his colleagues on the Liverpool Tramways Committee on his appointment as Government Supervisor of explosive material.

Mr. Alexander Spencer, a director of Messrs. George Spencer, Moulton and Company, Limited, has been elected a director of the British Westinghouse Electric and Manufacturing Company.

Belliss and Morcom.—The following have been added to the board of this company:—Mr. John Belliss, M.I.Mech.E.; Mr. E. L. Morcom, B.A., A.M.Inst.C.E.; and Mr. F. O. Everard, M.Inst.C.E.

Mr. S. H. Barnett, Lower Edmonton, London, has been appointed temporary clerk in the Swindon Electricity and Tramways Department, to fill the vacancy caused by Mr. E. G. Barling joining the colours.

Lieutenant G. C. Milnes, electrical engineer of the Lancaster Electricity Supply and Tramways Departments, is on active service. Mr. J. B. Patterson, the works superintendent, is performing Mr. Milnes' duties in his absence.

Mr. J. R. Lilleker has been appointed assistant electrical engineer by Rotherham Town Council. Mr. Lilleker has been on the Rotherham staff for some years. He succeeds Mr. J. Williams, now electrical engineer and tramways manager at Erith.

Mr. R. K. Morcom, a director of Messrs. Bellis and Morcom, has been granted a commission in the Royal Naval Division and is going on active service, the directors having granted him leave of absence. Mr. N. A. Morcom has joined the Honourable Artillery Company.

Mr. W. M. Furniss has been appointed by the directors of the Electric Construction Company, Limited, as manager of the company's works at Wolverhampton in succession to the late Mr. William Bulloch. Mr. Furniss took up his duties as a manager on the 17th inst.

Sir Gilbert H. Claughton, chairman of the London and North Western Railway, was on March 10 elected chairman of the Railway Companies' Association for 1915, and Lord Bessborough, chairman of the London, Brighton and South Coast Railway, was elected deputy-chairman.

Captain H. Clifford Palmer.—The promotion is announced in the *London Gazette* of March 17 of Second Lieutenant H. C. Palmer to a captaincy. Captain Palmer is publicity manager of the General Electric Company, and is attached to the 14th County of London Regiment, generally known as the London Scottish.

Sir George Askwith, of the Board of Trade, Sir Francis Hopwood, of the Admiralty, and Sir George Gibb, of the War Office, have been appointed by the Government as a committee to settle differences between employer and employed, and so to prevent strikes. Mr. H. J. Wilson is the secretary of the committee, whose address is 5, Old Palace Yard, London.

Mr. J. J. M'Mahon, electrical engineer of the overhead department of the Manchester Tramways, was a passenger on the torpedoed vessel "Aguila," and was rescued in the open sea by the s.s. "Lady Plymouth." Mr. M'Mahon was bound for the Canaries on holiday, and the "Lady Plymouth," being bound for that destination, he continued his voyage in that vessel.

Southampton Tramway Managership.—Out of 48 applicants for the vacant managership of Southampton Tramways, the following have been selected for further consideration:—Mr. H. Pilling, general manager and engineer of Accrington Tramways; Mr. F. Buckley, manager of Wigan Tramways; Mr. W. Billington, assistant to the general manager of the Salford System; Mr. W. T. Robson, general manager and engineer of the South Shields Tramways.

Mr. Marten Turner has been appointed general manager of the North Ormesby, South Bank, Normanby and Grangetown Railless Traction Company. Until the completion of the new offices of the company, Mr. Turner's address will be care of Mr. W. P. Ingham, Royal Exchange, Middlesbrough. Mr. Turner was for some years with the Colne and Trawden Light Railway Company up to the time of the transfer of that undertaking to the Colne Corporation and the winding up of the company. The railless traction system at North Ormesby is now under construction, and it is expected that the lines will be ready for working during the present year.

Glasgow Tramway Employee made a Lieutenant.—Lieut. Angus MacPherson, 2nd Argyle and Sutherland Highlanders, recently recommended for the distinguished conduct medal, was an employee in the Glasgow Tramways Department up till the beginning of the war. As a private in the 1st Scots Guards he was engaged in the fighting at Mons, the Marne, the Aisne, Ypres, and La Bassée, the young soldier being promoted to the rank of sergeant on December 10. He was mentioned in the despatches of December 25 and 27 and January 1 for particular devotion to duty. On February 4 he was gazetted lieutenant. Lieut. MacPherson, who is only 26 years of age, had the honour of being summoned to appear before the King.

Mr. James Bird, who has just been appointed Clerk of the London County Council, has been Deputy Clerk since 1905. Mr. Bird, who is 52 years of age, has been in the service of the Council and its predecessors since 1881, when he was appointed a member of the staff, after competitive examination. The General Purposes Committee of the London County Council, in recommending Mr. Bird's appointment as Clerk to the Council, said that during Sir Laurence Gomme's absence through illness in 1913, Mr. Bird performed the duties of Clerk of the Council in a completely satisfactory manner, and they had no hesitation in saying that his promotion would be in the best interests of the Council.

The late Mr. W. Edgar Allen, of Edgar Allen and Company, Limited, Imperial Steel Works, Sheffield, left £271,068 gross and £251,792 net. Various charities and employees benefit to the extent of £150,000. After various legacies are dealt with, he leaves two-fifths of the residue to the University of Sheffield, partly to the Committee of the Applied Science Department, and partly for founding Edgar Allen scholarships for students at the University.

INSTITUTION OF ELECTRICAL ENGINEERS.

Nominations by the Council of the Institute of Electrical Engineers for the new council for 1915-16 were issued on April 1. The Council desired unanimously to nominate Sir John Snell for a second year of office as President, but for reasons of health, and on account of the claims of professional work, he felt unable to undertake a second year of office.

Mr. C. P. Sparks has, therefore, been nominated. He is engineer-in-chief of the County of London Electric Supply Company, and has a large consulting practice.

Dr. Alexander Russell (Principal, Faraday House) and Mr. Roger T. Smith (electrical engineer to the Great Western Railway) are nominated as vice-presidents in succession to Messrs. W. Judd and C. H. Merz, whose period of office has terminated; the two vice-presidents, who remain in office, are Mr. J. S. Highfield and Mr. C. H. Wordingham. Mr. Robert Hammond is nominated for re-election as honorary treasurer.

There are five vacancies for ordinary members of council, and eight nominations have been made for the ballot next month: Mr. W. A. Chamen (engineer and manager of the South Wales Electric Power Distribution Company), Mr. H. Dickinson (city electrical engineer, Liverpool), Mr. H. W. Firth (electrical engineer to the Great Eastern Railway), Prof. T. Mather, F.R.S. (professor of electrical engineering, City and Guilds Engineering College), Mr. H. Faraday Proctor (city electrical engineer, Bristol), Mr. G. S. Ram (H.M. Electrical Inspector of Factories), Mr. W. Slingo (engineer-in-chief to the Post Office), and Mr. A. H. Walton (manager, Rugby Traction Department, British Thomson-Houston Company).

The five vacancies are caused by the retirement in the ordinary course of Messrs. F. Gill, W. Rutherford, A. H. Seabrook, and by the nominations of Dr. Russell and Mr. R. T. Smith as Vice-Presidents. The ordinary Members of Council who remain in office are Messrs. R. A. Chattock, J. Christie, Prof. B. Hopkinson, F.R.S., G. W. Partridge, W. H. Patchell, R. J. Wallis-Jones, and W. B. Woodhouse.

The three Associate Members of Council all remain in office, and are Mr. F. E. Berry, Major E. O. Henrici, R.E., and Mr. A. W. Martin. Mr. E. Russell Clarke and Mr. A. M. Ogilvie, C.B., remain in office as Associates on the Council, but Mr. H. C. Levis retires, and Mr. J. Hunter Gray (a well-known barrister in patent actions) is nominated in his place.

London County Council Highways Committee. The members of the Highways Committee of the London County Council, which controls the tramways, have been appointed as follows:—The Lord Monk Bretton, Sir John Benn, Messrs. D. Davies, G. A. Dutfield, H. H. Gordon, W. Haydon, G. H. Hume, William Hunt, Henry Marks, Theodore Prestige, A. Cooper Rawson, A. H. Scott, W. J. Squires, S. Joyce Thomas, Henry Ward, and A. W. Yeo. Mr. G. H. Hume has been re-appointed chairman of the Highways Committee, and Mr. Theodore Prestige has been appointed vice-chairman. Mr. G. H. Hume has been elected by the Highways Committee as their representative on the General Purposes Committee, and Mr. S. Joyce Thomas as representative on the Stores and Contracts Committee.

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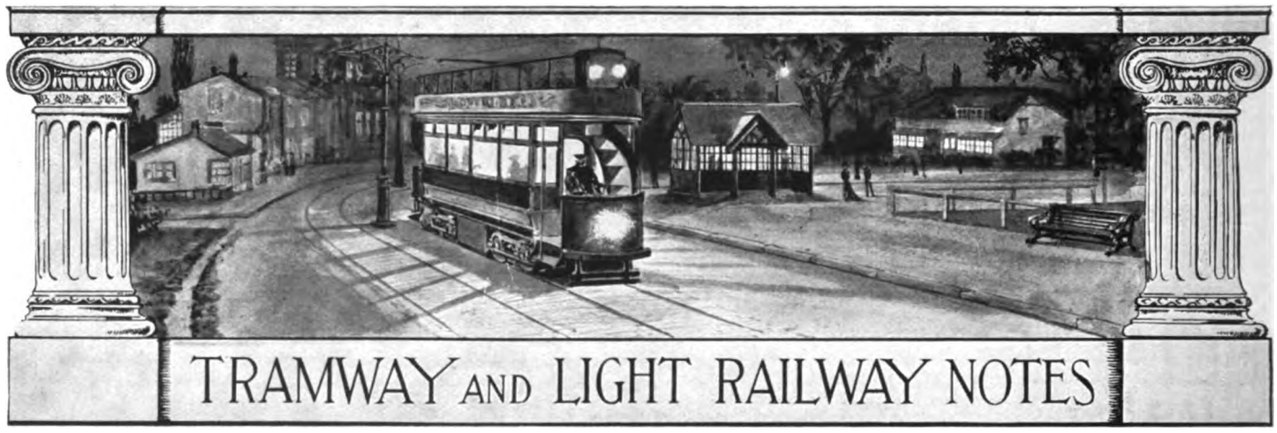

TRAMWAY AND LIGHT RAILWAY NOTES

BRADFORD.

New Car Shed.

The Tramways Committee of Bradford Corporation surveyed the Bolton Road district on March 22 with a view to securing a site for a new tramcar shed nearer to the city. A place near Peel Park and another site were examined, but no decision was taken.

BELFAST.

Post Office Employees on Tramcars.

Under an agreement with the Tramways and Electricity Committee, Belfast postal authorities paid the sum of £1,250 per annum for the conveyance of postal officials on the tramcars while on duty. The period of agreement expired recently, and it was remitted to Mr. Andrew Nance, the tramways manager, to arrange a scheme instead of the agreement, in consultation with the postal authorities. Under the new scheme, tickets are issued to the Belfast postmaster at their face value, subject to a reduction of 25 per cent., for the use of post office officials on the tramways.

BURY.

Official Inspection of New Lines.

On Tuesday, February 23, Lieut.-Colonel Druitt, on behalf of the Board of Trade, inspected the extensions to the Limefield and Jericho sections of Bury Corporation Tramways. He was accompanied on his tour of inspection by Alderman Collinge, chairman of the Tramways Committee, Mr. J. A. Settle, borough engineer, and Mr. W. Clough, tramways manager. Colonel Druitt expressed himself as well satisfied with the work, and the running of the cars was subsequently officially sanctioned.

CARDIFF.

Employees' War Allowances—Free Rides for the Blind.

Sir John Courtis, chairman of the Tramways Committee, moved an important resolution at the meeting of Cardiff City Council, held on March 8. The resolution proposed that all employees of the tramways department who are married, or are single with dependents, who have enlisted, or who may enlist, should have their wages made up. It was provided that the resolution should not be retrospective, and that no employee should enlist without obtaining the sanction of the tramways engineer and manager. It was pointed out that other employees of the Corporation had enlisted, and were equally deserving of consideration. Sir John Courtis said that he had no objection to including all employees of the Corporation in the resolution. After discussion it was decided to refer the matter to the Wages Committee of the Council.—Mr. Arthur Ellis, electrical engineer and manager of Cardiff Tramways, has reported to the Tramways Committee on the proposal to grant free rides to the blind on their tramcars. Mr. Ellis stated that replies to his inquiries from 72 electrical tramway concerns show that in 39 cases the privilege was granted, the passes being issued from institutions for the blind. The committee agreed to postpone decision until after the war.

COLWYN BAY.

Completion of Extension.

The electric tramway line from Colwyn Bay to Old Colwyn is now completed and fully equipped, and all the contractors' plant has been removed. The road widening work which was necessary to accommodate the tramway traffic with the ordinary traffic is not yet finished in some places, but is being pressed forward. On Friday, March 26, Colonel Druitt, the Board of Trade inspector, will visit Colwyn Bay for the purpose of inspecting the new line, and if, as is expected, he is satisfied that it is satisfactorily constructed, the regular traffic will commence on the same day. The extension is nearly two miles in length, and will serve a considerable population on the route, as well as the residential and industrial population at Old Colwyn and Llysfaen.

CROYDON.

Capital for Extensions.

The Finance Committee of Croydon Borough Council submitted to a recent meeting of the Council two special reports on capital expenditure for the tramways. The first recommended application for a loan of £1,685 for additional loops on the Norwood and Addiscombe routes, £520 being for the Norwood route and £1,165 for the Addiscombe. The other recommended application for a loan of £1,272 for an auxiliary feeder cable on the Norwood route. Both recommendations were adopted.

DONCASTER.

Rolling Stock and Car Shed Extensions—Free Tram Rides for Councillors—Centre Poles.

The Town Council of Doncaster have adopted the recommendation of the Tramway Committee to expend £5,300 in additional tramcars, £1,850 in the enlargement of car sheds, £700 in covering in the Cheswold, and £500 for other subsidiary works in connection with the tramways. It is reported that Doncaster Town Council, meeting in committee, have resolved to grant themselves the privilege of free passes all over the corporation tramway system. The resolution will come up for confirmation at the next meeting of the Council. It was stated at a Council meeting, on March 3, that the Light Railways Committee intended to remove all the centre poles in the streets. Action was deferred, however, owing to the increased cost of doing the work during the war.

DUBLIN.

Tramway Company's Coal Supply.

A statement was made at the meeting of Dublin Corporation early in March to the effect that the Tramways Company would not be able to carry on their undertaking for want of coal. In response to the inquiry on the subject, Mr. W. M. Murphy, chairman of the Tramways Company, characteristically replied that he would guarantee the Councillor who made the statement against any additional wear and tear of shoe leather caused by the want of trams.

EAST HAM.

Extension of Speed Limit Required.

At the recent meeting of East Ham Town Council, the manager of the Corporation Tramways reported that the police had taken proceedings against two of the Council's motormen for exceeding the speed limit in Romford Road. It was agreed, on the recommendation of the Electric Lighting and Tramways Committee, that the Town Clerk be instructed to apply to the Board of Trade for the speed limit of the Council's tramcars on these highways to be increased to 12 miles per hour.

EDINBURGH.

Temporary Curtailment of Corporation Schemes.

The tramway projects of Edinburgh City Council are not likely to be important during the war. Even if they obtain the Parliamentary powers sought, only a small extension and some street widening will probably be undertaken this year. The erection of the electric power-station at Portobello, however, will be proceeded with, and estimates will shortly be invited for the construction of the buildings.

FIFESHIRE.

Extension of Time.

In their annual report, submitted to a meeting of shareholders held on Wednesday, February 24, the directors of Fife Tramway Light and Power Company state that, as their statutory powers for the construction of a tramway to Rosyth Naval Base and Inverkeithing expire in July, 1915, they have applied for an extension of time, and also for powers to construct a connecting line along the North Queensferry Road.

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GLASGOW.

SHORTAGE OF STAFF.

Mr. James Dalrymple, general manager of Glasgow Corporation Tramways, has reported to the Tramways Committee that he is still 300 men short of the regular staff, and that conductors and motormen are working practically seven days a week. In view of the scarcity of men to act as conductors, a deputation of the Women's Suffrage National Aid Corps has suggested to the Tramways Committee that women should be employed as conductors at the same wages and on the same conditions as men.

HALIFAX.

TRACK DOUBLING.

The Tramways and Electricity Committee of Halifax propose to carry out certain doublings of the existing tramways in the Halifax and Bradford Road, at an estimated cost of £912.

HULL.

COAL SUPPLY AND INCREASING EXPENSES.

At a meeting of the Hull Corporation Tramways Committee on March 24, reference was made to the need of supplementing the supply of power and the rise in the price of coal. A recommendation from the Corporation Coal Committee that no tenders for coal be entered into at present was adopted, and it was agreed to make purchases as the service required. On the present prices, it was stated, the increase in the cost of coal would represent about £2,000 on the year. The Lord Mayor (Mr. Hargreaves), who presided, said the position was abnormal. The Committee were going to be faced with a £6,000 increase in wages, £2,000 in coal, and, as all other stores might be expected to rise in similar proportion, he might say they would be faced with extra expenditure of £10,000. The Lord Mayor, replying to a member who suggested that the question of fares should be dealt with, said the Committee would do nothing in a hurry; the whole matter needed great consideration. There were only two ways of dealing with the situation, one of which must be adopted. It was impossible to carry on the service as it was being carried on to-day on account of the shortage of men, and the Committee would have to consider in the near future whether they should not take off what he might call some of the "luxury cars." At such a time as this some inconvenience must be borne all round.

LEEDS.

TOKENS FOR SPECIAL CONSTABLES—GUISELEY EXTENSION.

The Leeds Watch Committee has decided to purchase tokens from the Tramways Committee to be supplied to the special constables in order that they may use the cars in travelling to and from points of duty without payment.—The tramway line from Boar Lane, Leeds, to Guiseley has been extended by three-quarters of a mile. Good progress has also been made on the trackless system being carried forward to Burley and Otley, in Wharfedale. Mr. J. B. Hamilton, the general manager, has stated that he hopes to commence the service at the end of May or early in June.

LEICESTER.

LOANS FOR TRAMWAY ROAD IMPROVEMENTS.

At Leicester, on March 22, Mr. R. H. Bicknell, Local Government Board Inspector, held an enquiry into the application of Leicester Town Council for sanction to borrow sums of £1,994 and £3,817 for street improvements. In connection with the first item of £1,994, the Town Clerk explained that it was for the carrying out of a scheme of widening the Lutterworth Road at the boundary of the borough, a little beyond the Aylestone tram terminus. The Road Board had been approached with a view to a grant being obtained, this being an improvement of the nature contemplated by the Board. After consideration, the Board had consented to give a grant of £586 under certain conditions, and it was hoped that this amount of relief would be secured. The second item of £3,817, which the Corporation desired to borrow, was, the Town Clerk explained, for the purpose of carrying out the widening of the Welford Road at various points, involved mainly by the construction of the new tramway route. It was hoped in this instance, too, that a grant would be obtained from the Road Board. Mr Mawbey submitted plans of the proposed improvements, and explained the details of the work to be done. There was no opposition, and the enquiry was closed.

LIVERPOOL.

SPECIAL COMMITTEE TO CONSIDER WAGES.

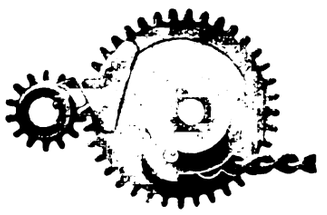
At the meeting of Liverpool City Council held on March 3, the following resolution was moved by Sir Charles Petrie:—"That a special committee be appointed to consider and decide what increase, if any, should be made in the salaries and wages of the officials and servants of the Corporation, including those employed temporarily, owing to the rise in the cost of the necessities of life since the commencement of the war, and as to the period during which such increase shall be given, and that the following members of the Council be appointed members of the special committee:—The chairman and deputy-chairman of the standing committees, Sir William Bowring, Alderman Salvidge, Mr. Burton Ellis, Mr. Lawrence D. Holt, Mr. Max Muspratt, Mr. Henry Jones, Mr. Alfred Gates, Mr. R. G. Hough, Mr. James Sexton, Mr. W. A. Robinson, Mr. John Clancy, and Mr. Richard Rutherford."

Note the STOPS which form the special feature of The "Peacock"

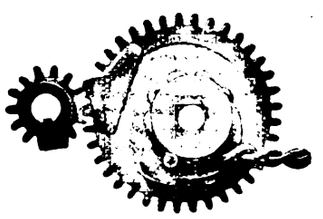
IMPROVED BRAKE

(Patent),

and by preventing the drum from over-running on release, save three quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



WINDING.

"PEACOCK" BRAKES

(PATENT)

TO THE NUMBER OF MORE THAN

50,000

HAVE BEEN

SOLD

IN ALL PARTS OF THE WORLD.

NOTE.—The stops being cast solid with the wheel and pinion in no way detract from the Simplicity of the Brake nor increase the cost of maintenance.

The "PEACOCK" BRAKE CO., 27, Clements Lane, LONDON, E.C.

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LOWESTOFT.

TRACK REPAIRS.

The engineer of Lowestoft Corporation Tramways reported to the Town Council meeting on March 10, that the condition of the track on certain portions of the route was in need of repair. He was instructed to proceed with the repairs at an estimated cost of £300.

NOTTINGHAM.

BETTER LIGHT POSSIBLE WITHIN MILITARY REGULATIONS.

It is reported from Nottingham that a well-known firm has fitted all the Corporation cars with shades for the car lights which effect the same purpose from an aerial point of view as the darkened lights at present in use, and at the same time afford a much improved light for those inside the car.

SHEFFIELD.

EXTENSIONS OF TRAMWAYS CLUB - SELLING PAMPHLETS ON CARS.

At the meeting of Sheffield City Council held on March 10, Sir William Clegg, chairman of the Tramways Committee, stated that it had been decided to make an extension to the Tramways Club, the accommodation there having become too small for the increased number of employees in the department. The cost would be advanced out of the accumulated tramway surplus, and would be repaid by the employees in an agreed term of years. At this meeting Alderman Marsh moved:—"That this Council disapproves the recent action of the Tramways Committee in authorising the sale by the tramway and omnibus conductors of pamphlets of a controversial nature, and instructs the Tramways Committee that in future the employees of the Tramways Committee shall not be engaged in the sale of literature, and that no notices or advertisments shall be published in the tramcars and omnibuses except such as are inserted by the authorised advertisement contractors, or relate to recruiting, or to the raising of relief funds by the Corporation, or to collections in aid or on behalf of philanthropic societies or associations."

SOUTHAMPTON.

NO MORE FREE RIDES.

Southampton Town Council remitted to the Tramways Committee some time ago the question of withdrawing from the military forces the privilege of free rides on the tramcars, and it was decided that the privilege should be withdrawn on March 15. Under the Southampton Tramways Act, soldiers and sailors enjoy the right of travelling the full distance on any line for one penny.

STOKE-UPON-TRENT.

LEASE OF POTTERIES ELECTRIC TRACTION COMPANY.

The County Borough Council of Stoke-on-Trent has had under consideration for some time the question of renewing the lease of the tramways in the borough to the Electric Traction Company. The proposal of the majority of the Council is to renew the lease for a period of 25 years, but a strong minority, consisting chiefly of Labour representatives, hold out for purchase of the tramways by the local authority. The draft agreement, which stipulates for certain payments by the company to the Corporation and improvements in the system, has been provisionally accepted by the Council, and a committee consisting of representatives of the six pottery towns appointed to consider details and report to a future meeting of the whole Council.

WEST HAM.

SANCTION FOR LOAN FOR PURCHASE OF CARS.

West Ham Town Council proposes to apply for sanction for a loan of £3,000 to cover the difference between the revised estimate for the purchase of 15 bogie cars and one single-truck car and the amount already sanctioned, and for £10,000 for car equipments. The latter amount is the sum required after deducting £18,000, which will be taken from the reserve fund.

WOLVERHAMPTON.

COMPENSATION LOST IN LAW EXPENSES.

At a recent meeting of Wolverhampton Town Council, a letter was read from the widow of motorman Simcox, who died while on duty on a tramcar, asking reconsideration of her case. It was stated that before the claim for compensation was raised by the widow in the County Court, she was offered £52 in settlement of her claim, but the offer was refused. At the hearing of the case the Court decided against the widow's claim, and the insurance company which defended the case incurred £57 of expenses. The Council decided that it was now too late to reopen the question, but referred the matter to the Tramways Committee for consideration.

War Bonuses at Paisley.—The directors of Paisley District Tramways Company have resolved to pay each employee, over and above his or her normal wage, a war emergency bonus. The scale is adjusted on the basis of 1s. per week to those having a normal wage not exceeding 20s. per week, and 2s. to all over 20s. per week. The allowances are to date from March 1, and will be paid every four weeks The directors, in intimating the bonus, take the opportunity of thanking the staff for their loyal support during the absence on service of the general manager and other members of the staff.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in *italics*.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

3,234 Railway brakes—F. E. Feesy.
3,242 Brake for vehicles—H. Barmby.
3,246 Gate-closing mechanism for tramcars—J. M. Stuart.
3,252 Ticket punches—A. C. Cronk and W. Mottershead.
3,311 Steam generators for motor road vehicles—T. Clarkson.
3,340 Fluid-pressure braking apparatus—A. W. Rendell.
3,350 Steam superheaters for locomotive boilers—A. Spencer.
3,358 Railway crossings—J. W. East.
3,383 Means for expediting and safeguarding railway traffic—H. A. Thompson.
3,386 Railway signalling apparatus—E. Sutton.
3,400 Protective covering for solid rubber tires—J. E. Blurton.
3,419 Signalling systems—A. Stern.
3,472 Brakes for motor vehicles—R. R. Mellor and T. M. G. Morton.
3,477 Automatic railway coupling—F. E. Applegate.
3,520 } Electric signalling systems—International Electric Company,
3,523 } Limited, H. E. R. Roose and R. G. le Noir.
3,526 Superheaters—G. M. Clark *(Locomotive Superheater Company)*.
3,539 Wheels with increased tread on track—B. C. Riblet.
3,579 Compresed air brake—F. J. Chapsal and A. L. E. Saillot.
3,581 Motor vehicles—J. C. Lobato.
3,679 Rail tie—B. J. Sheehe.
3,694 Springs for motor vehicles—R. Esnault-Pelterie.
3,712 Railroad ties—W. V. Polick.
3,728 Renewal of the wearing parts of trolley wheels of electric tramcars—L. Loukes and W. J. Hunter.
3,774 Electric signalling apparatus—E. Walker.
3,796 Collector gear for overhead trolleys—T. G. Poole.
3,902 Struts for bogies of railway vehicles—Leeds Forge Company, Limited, and R. G. Sharp.
3,910 Magnetic clutches, brakes, etc.—Compagnie de Fives-Lille.
3,928 Bonding devices for electrical conduit systems—D. L. J. Broadbent.
3,943 Route indicators for railway signalling—J. P. O'Donnell and S. L. Glenn.
3,948 Vacuum brake apparatus—E. S. Luard.
4,060 Lubricating axles of locomotives, tramcars, etc.—H. Hobson and A. Morris.
4,120 Differential gear for motor vehicles—L. W. Williams and R. Ainsley.
4,149 Railway signalling—W. R. Sykes Interlocking Signal Company, Limited, and R. W. Tarrant.
4,178 Starting devices for the engines of motor cars—A. Orr.
4,222 Motor control—Akt.-Ges. Brown, Boveri, et Cie.
4,423 Devices for controlling the speed of motor vehicles—J. H. Wilson and A. W. Romyn.
4,461 Tires for motor road vehicles—E. D. Self.
4,463 Folding signalling apparatus—A. J. M. Shaw.
4,484 Automatically variable gearing—A. R. Monro.
4,492 Lifting-jacks—T. H. Tessier and W. Dinnage.
4,495 Frame and cover for motor omnibuses and trams—C. T. Lunnis.
4,548 Change-speed gearing for motor vehicles—G. H. Robinson.
4,691 Lifting jacks or devices—J. F. Gregory.
4,728 Railway and like signalling—A. Kerr.
4,741 Reinforced concrete sleeper and rail-tie—E. W. Manning.
4,747 Electric motor controllers—Igranic Electric Company, Limited (Cutter Hammer Manufacturing Company).

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Amberley House, Norfolk Street, W.C
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4,757 Transmission of signals to railway and tramway vehicles—W. F. J. H. Bouman.
4,790 Compound rail—W. A. Seeley.
4,798 Brake mechanism for road vehicles—W. T. Bell and L. W. Jones.

Specifications Published.

1913.

26,326 Train warning signals—Goddin and Griffiths.
29,435 Axle boxes for rail vehicles—Lassmann.
29,540 Wheels for vehicles—Dunlop Rubber Company and Wright.

1914.

641 Railway signalling apparatus—Buenos Ayres and Pacific Railway Company *(Harte)*.
3,596 Current collecting devices for dynamo electric machines—British Thomson-Houston Company and Whitaker.
3,925 Electric power transmission, self-starter, and lighting system for motor vehicles—Roydhouse and Cheeseman.
9,436—Car trucks—Adams.
10,066 Brake mechanism for railway vehicles—Bowles.
11,221 Axle boxes—Pettigrew.
11,295 Superheaters—Stenning.
11,417 Steam superheaters—Litton.
12,847 Bogies of railway vehicles, etc.—Haigh.
15,086 Railway sleepers or ties—Brockway.
901 Electric railway and tramway systems—Aspinall.
2,459 Rear-axle drive for motor-propelled road vehicles—Proud and Proud.
4,332 Signals for railways—Davies and Morgan.
8,782 Road wheels for motor vehicles—Hayman and Hayman.
19,513 Vehicle brakes—Dutcher.
3,568 Detonating signals for use on railways—Ramsbottom.
4,554 Electric motor control systems—British Thomson-Houston Company *(General Electric Company)*.
5,341 Railway tie-bars and sleepers—Todd.
5,608 Foot-operating mechanism for motor vehicles—Daimler Company and Berriman.
5,903 Communicating with trains—Thompson.
9,415 Railway chair keys and wedges—Bowen.
16,492 Self-contained buffers for rolling stock—Watson and Boyd.
19,944 Electric railway systems—Mullaney.
5,351 Electrical train-controlling systems for railroads—Warthen.
5,513 Electro-magnetic brakes, etc.—J. P. Hall and Company.
5,854 Valve apparatus applicable for use with automatic vacuum brakes—Vacuum Brake Company, Dover and Walker.
8,340 Cover for seats of omnibuses, trams, etc.—Hickman.
10,025 Motor vehicles—Guy.
10,767 Brake mechanism for motor road vehicles—Daimler Company.
11,042 Steering hand-wheels for motor road vehicles—Bluemel Bros.
22,304 Railway trucks—Mower and Thursfield.
23,342 Axle boxes for railway vehicles—Woodhead and Elliott.

1915.

516 Means for operating the collapsible cover for the upper deck of omnibuses and tramcars—Beck.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. Mar. 7.	Mar. 14.	Mar. 21.	Mar. 28.	1915. WEEKS ENDED. Mar. 6.	Mar. 13.	Mar. 20.	Mar. 27.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	58,529	59,392	55,913	56,302	51,890	50,619	53,433	51,827	12	610,676	– 74,579
Auckland	(28 days)	23,332	...	...	(28 days)	19,907	...	...	36	186,935	+ 4,513
Burma	4,323	4,042	4,207	4,298	3,344	3,483	3,624	3,774	...	...	– 36,947
Calcutta ... ... Rs.	70,006	67,630	65,616	64,708	66,531	64,137	62,741	62,259	13	884,622	– 52,419
Hong Kong ... ... $	11,407	11,036	11,134	11,264	10,840	9,974	9,800	9,776	13	141,905	– 16,977
Madras ... ... Rs.	(2 weeks) 29,347	...	...	...	(2 weeks) 27,730	...	...	...	10	136,229	– 3,050

Companies Issuing Monthly Statements.

	1913 Oct.	Nov.	Dec.	1914. Jan.	Feb.	March.	1914. Oct.	Nov.	Dec.	1915. Jan.	Feb.	March.	Wks.	AGGREGATE. 1915.	+ or –.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Brazilian Traction Mlrs	6,098,850	6,009,487	6,142,209	6,194,227	...	...	6,241,170	5,929,730	6,010,490	5,996,190	...	...	5	5,996,190	– 198,037
Brisbane	27,250	27,053	29,145	28,330	25,260	...	28,763	28,600	30,890	29,620	26,590	...	9	56,210	+ 2,620
British Columbia $	753,541	746,152	793,219	777,102	...	...	661,000	648,485	674,063	640,495	...	...	31	4,639,394	– 691,434
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	12,223	...	14,147	14,646	13,342	...	12,682	...	15,869	15,660	13,924	...	9	29,584	+ 1,596
Carthagena & Herrerias	1,582	1,922	2,698	2,776	2,919	...	1,543	1,379	1,255	904	1,822	...	9	2,726	– 2,969
Cordoba	13,278	...	12,863	...	...	...	12,919	...	12,119	...	...	...	39	119,457	– 845
East India	1,878	1,922	2,046	1,938	1,701	...	2,007	2,029	1,839	1,914	1,649	...	30	13,530	+ 12
Kalgoorlie	2,652	2,504	2,907	2,340	...	...	2,525	2,414	2,905	2,372	...	...	5	2,372	– 32
La Plata	4,920	5,409	5,505	5,296	4,766	...	4,540	4,540	4,452	4,540	4,016	...	9	8,556	– 1,506
Lima	35,175	33,236	38,091	37,870	33,779	...	30,648	29,749	32,112	33,042	30,173	...	9	63,215	– 8,434
Manila ... ... $	148,000	154,950	154,000	137,000	153,300	...	125,750	129,000	132,500	127,500	123,000	...	9	250,500	– 39,800
Melbourne	65,000	68,767	...	68,500	...	...	63,328	66,402	...	62,729	...	...	5	62,729	– 5,771
Mexico ... ... $	616,007	605,467	...	...	...	...	558,990	643,961	...	...	...	...	47	6,716,716	+ 378,911
Montevideo	...	30,531	33,310	38,256	35,805	...	...	27,081	28,605	32,443	30,007	...	17	118,136	– 19,765
Port Elizabeth ..	3,553	...	4,367	4,830	3,510	...	3,372	...	3,986	4,102	3,149	...	9	7,251	– 1,089
Puebla ... ... $	63,000	69,700	65,600	...	...	...	49,100	45,900	40,000	...	...	...	52	669,500	– 44,500
Rangoon	5,963	5,686	5,424	5,163	5,009	...	4,600	4,405	4,459	4,689	4,991	...	9	9,680	– 492
Toronto ... ... $	861,235	849,279	...	847,945	...	...	849,636	824,634	...	843,351	...	...	5	843,351	– 4,594
Winnipeg ... $	357,313	360,082	379,863	382,670	...	...	330,562	330,398	368,400	350,681	...	...	5	350,681	– 31,989

(*Continued on page 288*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	Mar. 7.	Mar. 14.	Mar. 21.	Mar. 28.	Mar. 6.	Mar. 13.	Mar. 20.	Mar. 27.	Wks.	1914—15.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1,550	1,494	1,459	1,433	1,576	1,609	1,650	1,532	43	70,614	+ 2,245
Accrington	533	544	553	546	470	499	495	...	50	26,470	- 2,337
Ayr Corporation	240	232	240	232	224	225	229	236	45	15,060	- 1,197
Bath Electric	745	717	*	...	646	660	...	...	10	6,331	- 725
Birkenhead Corporation	1,210	1,213	1,205	1,773	1,227	1,216	1,270	1,230	51½	64,623	- 2,769
Birmingham Corporation	12,322	12,280	12,493	12,483	12,515	12,497	12,344	12,554	52	632,192	+ 10,379
Blackburn Corporation	1,195	1,127	1,164	1,235	1,015	1,055	1,115	1,051	52	63,721	- 2,908
Blackpool and Fleetwood	370	270	302	285	373	285	257	284	12	3,644	+ 26
Blackpool Corporation	789	568	552	537	861	581	551	574	52	74,967	- 8,683
Bolton Corporation	2,607	2,615	2,565	2,596	2,547	2,546	2,466	2,416	52	138,453	- 2,980
Bournemouth Corporation	1,644	1,656	1,603	1,720	1,816	1,870	1,807	1,755	52	102,814	- 1,539
Bradford Corporation	5,866	5,825	5,614	5,808	5,545	6,418	5,714	5,810	52	316,659	+ 10,592
Brighton Corporation	781	802	813	828	800	834	831	812	51½	54,083	- 288
Bristol	7,587	7,395	7,250	7,411	8,684	8,518	8,513	8,682	12½	101,208	+ 10,866
Burnley Corporation	1,570	1,770	1,591	1,541	1,449	1,409	1,388	1,386	52	78,248	- 9,498
Burton-on-Trent Corporation	285	276	273	271	264	254	246	248	52	15,056	- 21
Bury Corporation	1,309	1,279	1,295	1,253	1,270	1,268	1,244	1,194	51½	68,399	- 1,129
Cardiff Corporation	2,660	2,573	2,654	2,657	2,460	2,392	2,403	1,554	51	137,468	- 3,066
Chatham and District	835	811	810	831	976	996	1,022	1,012	12	11,553	+ 1,792
Chesterfield Corporation	260	249	260	434	243	249	245	...	50	13,283	+ 189
Colne Corporation	232	251	242	242	215	220	205	207	—	—	—
Cork Electric	447	447	471	445	437	457	481	441	12	5,224	- 162
Croydon Corporation	1,590	1,504	1,508	1,599	1,606	1,564	1,622	1,676	51	86,703	+ 2,739
Darlington Corporation	248	240	247	247	249	250	251	242	52	13,479	+ 545
Derby Corporation	959	948	905	928	962	935	919	939	51½	51,243	+ 583
Dover Corporation	193	199	190	213	250	244	248	244	52	13,137	+ 804
Dublin and Lucan	114	111	128	110	113	109	149	120	12	1,401	+ 14
Dublin United	5,455	5,264	5,605	5,173	5,422	5,441	5,920	5,521	12	66,946	+ 3,482
Dundee City	1,264	1,211	1,216	1,245	1,203	1,215	1,258	1,161	44½	56,952	- 1,213
East Ham Corporation	1,048	1,018	1,011	1,009	1,238	1,236	1,239	1,273	51½	61,242	+ 8,063
Exeter Corporation	296	293	286	295	298	299	299	303	52	17,769	+ 461
Gearless Motor 'Buses	*	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	20,850	20,117	20,979	21,349	20,133	20,711	20,749	20,438	42	868,253	- 6,757
Glossop (Urban Elec. Supply Co.)	120	121	115	116	108	107	100	110	13	1,390	- 159
Halifax Corporation	1,903	1,840	1,908	1,928	1,801	1,875	1,967	1,933	51	109,566	+ 2,943
Hastings and District	801	758	718	757	705	707	844	744	12	8,576	+ 73
Huddersfield Corporation	2,135	2,080	2,188	2,130	2,248	2,326	2,329	2,401	52	141,734	+ 11,653
Hull Corporation	3,202	3,209	3,215	3,140	3,049	3,087	3,088	3,082	51	160,190	- 4,514
Ilford U.D. Council	455	451	451	458	576	557	563	563	52	29,595	+ 6,391
Ilkeston Corporation	125	127	123	123	114	114	116	110	52	6,529	- 401
Ipswich Corporation	378	370	372	384	368	363	379	388	52	22,616	- 367
Isle of Thanet	333	308	310	362	240	234	236	260	25	7,287	- 357
Kilmarnock Corporation	143	155	146	158	165	140	164	147	45	7,167	- 708
Lanarkshire	1,806	1,821	1,779	1,861	1,635	1,747	1,727	1,711	12	20,911	- 1,181
Lancashire United	1,538	1,512	1,525	1,534	1,483	1,579	1,527	1,542	12	18,093	- 118
Leeds City	8,071	7,958	7,897	8,085	7,917	8,056	8,110	8,114	52	425,610	+ 7,316
Leicester Corporation	2,814	2,913	2,799	2,879	2,835	2,820	2,830	2,820	13	34,592	+ 522
Leith Corporation	649	641	679	669	630	648	650	657	45	31,607	- 108
Leyton U. D. Council	...	...	...	...	...	...	...	...	—	—	—
Liverpool Corporation	12,793	12,729	12,645	13,540	12,379	12,499	12,491	13,539	12	153,504	- 3,183
Llandudno and Colwyn Bay	163	163	164	163	246	193	189	202	16	2,924	+ 439
London County Council	42,569	42,289	42,554	42,694	46,554	46,916	47,433	47,162	51	2,286,851	+126,988
London General Omnibus	*	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	151	148	149	149	140	143	143	144	25	4,143	- 360
Maidstone Corporation	177	168	159	171	158	163	168	162	52	10,262	- 15
Manchester Corporation	17,358	17,101	17,243	17,875	16,259	16,449	16,319	17,517	52	884,794	- 20,672
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	184	200	187	186	150	152	149	151	51½	9,231	- 1,496
Newcastle-on-Tyne Corporation	4,998	4,880	4,937	5,041	5,604	5,795	5,723	5,866	52	287,892	+ 31,789
Newport (Mon.) Corporation	746	754	738	780	750	741	742	753	52	41,629	+ 1,565
New St. Helens and District	769	771	764	738	859	897	874	908	38	34,767	+ 3,543
Northampton Corporation	536	535	543	522	671	660	685	714	51½	31,163	+ 1,650
Nottingham Corporation	3,288	3,298	3,369	3,435	3,229	3,308	3,507	3,408	51½	174,253	+ 1,819
Oldham Corporation	2,115	2,147	2,118	1,566	2,124	2,009	2,097	1,209	52	111,188	- 2,989
Portsmouth Corporation	1,952	1,886	1,774	1,922	2,106	2,096	2,124	2,083	52	120,919	—
Preston Corporation	823	826	864	805	837	852	842	849	52	46,590	+ 1,047
Provincial	1,679	1,592	1,589	1,665	1,888	1,890	1,926	1,919	24	48,284	+ 5,243
Reading Corporation	648	667	646	661	642	647	660	669	51	35,951	+ 394
Rochdale Corporation	1,467	1,509	1,449	1,487	1,466	1,474	1,434	1,525	52	82,010	- 82
Rhondda Tramways	1,198	1,196	1,210	1,187	1,118	1,131	1,163	1,103	12	13,191	- 777
Rotherham Corporation	866	883	867	844	963	987	954	924	52	52,722	+ 581
Salford Corporation	5,065	5,060	5,051	5,182	4,803	4,672	4,907	4,677	51	255,399	- 15,655
Sheffield Corporation	7,783	7,698	7,586	7,656	8,087	8,182	8,088	8,077	51½	402,438	+ 11,520
Southampton Corporation	1,159	1,173	1,182	1,168	1,193	1,174	1,215	1,195	51	66,866	+ 187
Southend-on-Sea Corporation	722	715	698	711	619	645	672	661	51	47,932	+ 1,178
South Metropolitan Tramways	*	...	...	...	...	...	...	...	—	—	—
South Shields Corporation	688	682	714	691	668	685	716	708	51½	38,587	+ 1,496
Sunderland Corporation	1,355	1,355	1,277	1,322	1,267	1,352	1,296	1,302	52	74,662	+ 262
Sunderland District	554	534	556	530	508	532	557	494	21	10,820	- 1,030
Swindon Corporation	152	160	153	163	162	159	168	169	51	9,069	+ 632
Torquay Tramways	414	418	416	408	410	421	464	436	12	4,859	+ 97
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	500	476	508	471	495	518	559	513	12	5,966	+ 280
Wallasey Corporation	1,098	1,102	1,105	1,214	1,053	1,049	1,046	1,096	51½	62,622	+ 288
Walsall Corporation	621	624	623	602	664	660	652	666	13	8,147	+ 497
Walthamstow U.D. Council	731	689	688	722	730	710	743	748	51½	40,962	+ 2,810
Warrington Corporation	456	442	442	428	429	424	423	426	51	22,270	- 604
West Ham Corporation	2,725	2,675	2,697	2,725	2,824	2,818	2,900	2,907	51	145,087	+ 5,584
Wigan Corporation	1,491	1,483	1,475	1,528	1,405	1,415	1,379	1,394	51	74,343	- 2,515
Wolverhampton Corporation	1,034	1,072	1,010	1,036	975	1,037	980	950	53	54,593	- 1,872
Yorkshire (West Riding)	1,385	1,429	1,384	1,368	1,404	1,439	1,362	1,448	13	18,406	- 23

* Publication of Traffic Returns suspended during the war.

ELECTRIC RAILWAY TRAFFIC RETURNS.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officials and the principal particulars relating to each undertaking.

The directory is revised as occasion requires, and is the most up-to-date and comprehensive list published.

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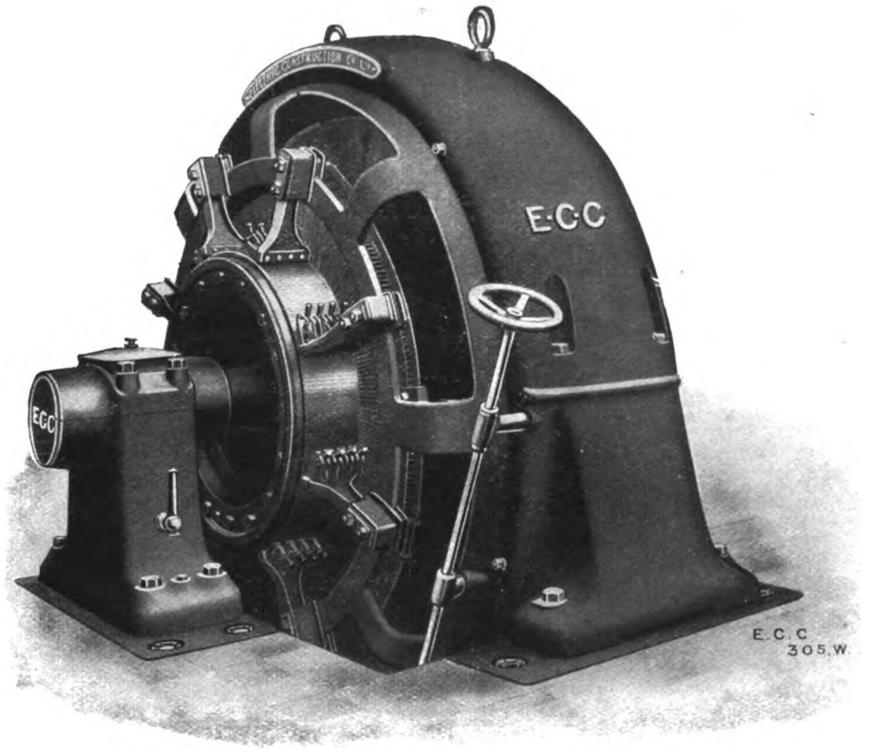

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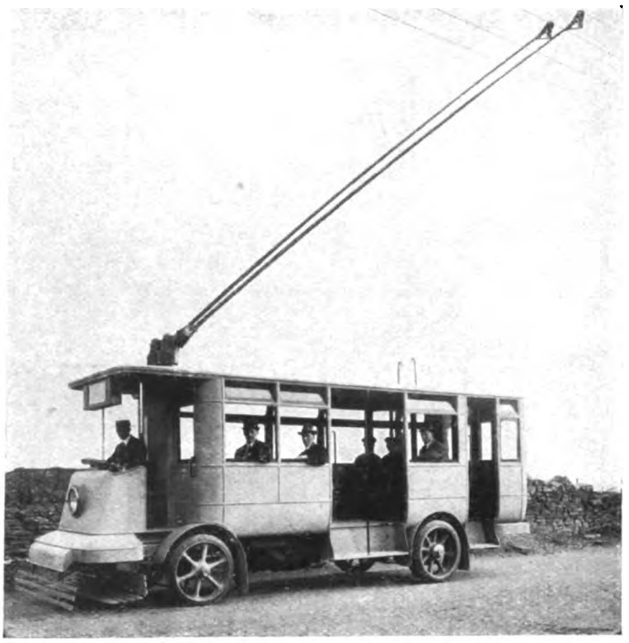

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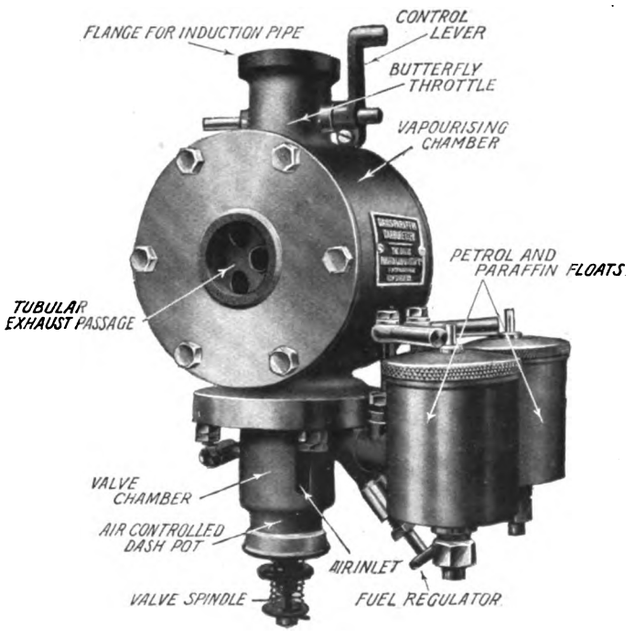

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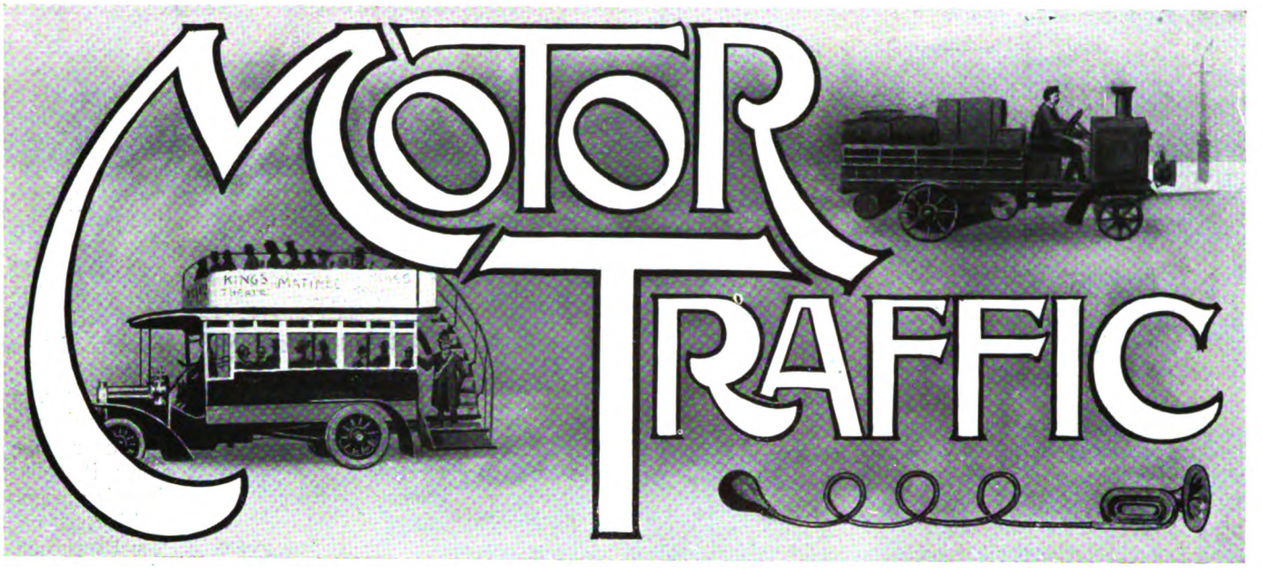

In arranging to take over factories to be used in assisting Government contractors to supply the War Office and the Admiralty with sufficient rapidity, the principle of compensation for interference with business is recognised as morally, if not necessarily legally, sound. If the proprietors of such factories have contracted to supply certain goods, and are now prevented from doing so, the loss of business will apparently be recognised and made good. The position is very similar to that of many of the concerns that have since the beginning of the war been almost completely engaged on Government contract work. Take, for example, the case of a motor lorry manufacturer who was under contract to deliver considerable numbers of vehicles to his agents and to individual purchasers. It would surely be reasonable, at any rate in the case of agents whose whole livelihood depends upon sales of vehicles, to recognise the loss of business and of goodwill following upon the requisitioning of the machines. Before definitely getting an order for a lorry, the agent generally has to do a good deal of spade work, and often to incur some expense. The car having been requisitioned, it is highly probable that all this has become time and money wasted, since his principals are unlikely to be able to deliver for some time to come, and the user is probably compelled to purchase any reasonably efficient vehicle on which he can lay his hands.

* * * *

A rather similar case is that of the corporations, companies or individuals operating motor omnibuses or chars-a-bancs. Whereas the average motor van is merely part of the equipment of a single department of its proprietor's business, the chars-a-banc or omnibus is often the prime or sole source of profit. Its value to its owner at a time when it cannot be replaced is by no means adequately represented by its first cost. In losing it, he loses not only a vehicle worth so many hundred pounds, but the whole of his prospective profits until he can get another car on to the road. There seems here to be a very reasonable case for compensation. There have apparently been certain instances in which corporations have objected to the suggestion of replacing omnibuses commandeered from them. If this be so, their action strikes one as being the reverse of patriotic. The fact that motor omnibuses can he turned to good account as weapons of war ought to encourage and not discourage their use by public bodies. If everyone took up the narrow view and refused to own anything which could conceivably be of use to the country in time of war, the position in the event of a sudden outbreak would be very serious, and a responsible public body is hardly expected to set such an example by refusing to employ vehicles that can be utilised for military service. Certainly, at the present moment there is the chance of further vehicles being commandeered. There is also a great difficulty in getting new cars to replace them. If, however, corporations after the war decide that the possibility of a recurrence of such circumstances justifies them in blackballing the motor omnibus, they will be assisting materially in making it impossible for manufacturers to continue to produce machines which are now not merely a convenience, but an absolute necessity if troops in the field are to be properly fed.

The matter to which we have referred in the foregoing paragraphs is not the only danger which the industrial motor industry has to face as a result of the magnificent work which it is now doing for the Empire. A question which we believe has already received some attention by the officials of the War Department, and also by the Society of Motor Manufacturers and Traders, is the proper course of action when the time comes to reduce the Government supply of lorries. Roughly speaking, there are two alternatives if we assume that there will be a period of decreased demand before the contracts are terminated altogether. One is to reduce the number of contractors and for the Government to retain the whole output of those remaining on the list: the other is to reduce the demand upon each firm to some agreed percentage of the total output. The first system from a military standpoint has an obvious advantage, which is that it helps towards complete standardisation and the reduction of types. It may be presumed, however, that by the time the contracts are reduced at all, the importance of limiting types will not be so great as it is at present. The drawback of the system is from the trading standpoint a serious one. It would mean holding up the normal output of certain manufacturers and preventing them from replacing the vehicles of their make requisitioned from users at a time when other manufacturers would be freed, and would consequently be in a position to fill ordinary orders. This means that the goodwill of those firms specially selected to continue their contracts would suffer seriously, and that these firms as a reward for the special merit of their cars

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MOTOR TRAFFIC.

would be unduly handicapped as against their trade competitors. We cannot, of course, expect the War Department in the interests of trade to do anything which they believe to be detrimental to military efficiency up to the final termination of the war. At the same time, it would not be to their ultimate interests to create in the motor trade a feeling that those firms which endeavour whole-heartedly to supply military needs will in the event of war suffer a disproportionate injury to their trade.

* * * *

Yet another important question is what is to happen to the enormous number of second-hand machines which will presumably be brought back from the Continent at the end of the war. There will of course be plenty that no one will trouble to ship home. At the same time, there will be a very considerable number of thoroughly serviceable lorries, and the effect of suddenly dumping perhaps three or four thousand such vehicles on to the market just after the war is over would be extremely serious. Perhaps the greatest danger lies in the fact that there will be speculators waiting to buy up big fleets at low prices, and then to dump them on to the overseas markets regardless of the fact that by so doing the prestige to British manufacturers will almost certainly be permanently injured. Convoy work on roads completely broken up, intentionally or otherwise, and with convenient repairing facilities limited to a workshop car, does not conduce to perfect reliability of the second-hand machine, and makes it almost certain that in some details at least such a machine would have been made the subject of emergency repairs of a more or less makeshift character. Unless infinite harm is to be done, the War Department and Admiralty certainly ought not to allow any of the cars they own to be put on to the second-hand market without first having passed through the works of their manufacturers, so that every vehicle carries its maker's guarantee of thoroughly sound condition. The expense of the overhauls necessary before such guarantees could be given would of course be considerable, but if intelligent methods of ultimate sale were adopted, the increase in the market value of the vehicle following upon the maker's guarantee, would more than make up the difference. Moreover, if the Government wishes in the future to feel that the motor industry is at its disposal, it would obviously be bad policy to inflict needless injuries on those firms which during the present war have done the most valuable work.

The requirements of this country for motor vehicles both for commercial and public passenger services at home and in the war area are still keeping the works fully employed. Those makers who during the past three years had taken steps to enlarge their establishments and to train additional hands are reaping the greatest advantage from the inrush of Government and civil orders, and the abnormal activity is likely to continue for an indefinite period. On several occasions, both before and after the revival of the exhibitions of heavy motors, the advisability of extending works was discussed and urged in these columns, for the indications of increasing popularity of the motor vehicle were unmistakable in three directions. The most prominent tramway undertakings had at the outset of our prognostications begun to experiment with the petrol vehicle, following the lead of two or three tramway companies and a few municipalities, apart from the great example of London. Increasing popularity also was gained by the summer chars-a-bancs traffic, many additional local caterers taking up and extending this class of enterprise in which the railway companies were the pioneers, although using a vehicle far less comfortable and suitable than the present-day machine. Last year and the year preceding it there was witnessed the sensible action of numerous company-owned tramway organisations continuing to institute federations for the carrying on of pleasure, public passenger, and business motor traffic over a wide area, often embracing one or more counties. The wisdom of thus securing control of a competing factor and using it to the advantage of existing traction undertakings is apparent from several points of view. The profitable nature of such a course has been demonstrated for a number of years by the Bristol Tramways and Carriage Company, and it is bound before long to receive further emphasis as the result of the amalgamation of the London General Omnibus Company and the two great company tramway undertakings of Greater London.

Satisfaction must be expressed that the Local Government Board, despite the hindrance to special business on account of problems arising from the European War, have not lost sight of the question of road maintenance. In addressing recently the Council of the County Councils' Association, Mr. Herbert Samuel, President of the Local Government Board, observed that the military and naval expenditure had modified profoundly the financial plans of the Government, and he feared that the prospect of obtaining much-needed aid from the Exchequer for local finance was worse than a few months ago. It will be recalled that in the early part of last year the Chancellor of the Exchequer's proposals for the State to bear a much larger share of the cost of road maintenance had to be deferred on a point of procedure.

In view of Mr. Samuel's statement, local authorities will have to continue for an indefinite period under the present arrangement to defray too large a proportion of the cost of the roads, having regard to the fact that the prevalence of motor traffic has rendered the main roads more national than local in importance. Referring to motor traffic, the President of the Local Government Board remarked that, even amidst the state of affairs brought about by the war, it might be possible to have a Committee of both Houses to investigate the question of contribution to the upkeep of the roads by the owners of motor vehicles. In war, as in peace, he added, motor lorries and omnibuses and traction engines tore up country roads, although lately their energies had been devoted to the roads of France and Belgium. To the achievements of motor vehicles of all kinds both Great Britain and France owe a debt of gratitude. This fact renders it incumbent on the local authorities to reconsider their demand for the imposition of increased taxation on heavy motors. A statesmanlike course would be to recognise the national character of both motor traffic and the main roads. It will be remembered that last summer the Legislature agreed to the appointment of a Joint Committee to inquire into the existing conditions of taxation of heavy motors. It would be well if the interests concerned were to press upon the Government the necessity for the Committee taking up their task without further delay.

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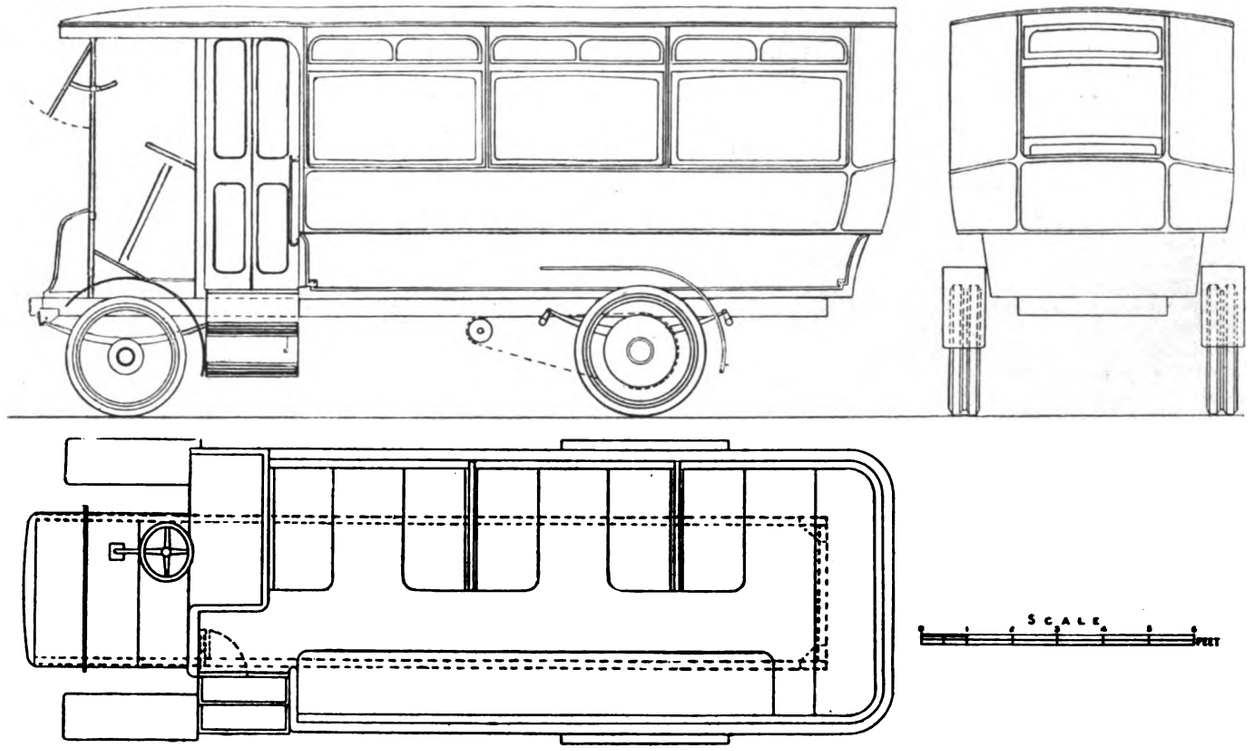
MOTOR TRAFFIC.

EDISON ACCUMULATOR OMNIBUSES FOR YORK CORPORATION.

A regular service of electric omnibuses has now been inaugurated by the Corporation of York. The last of the four vehicles ordered from Edison Accumulators Limited, was delivered on March 22. Each of these vehicles was sent down by road from London, and although the run was made in easy stages with no idea of making any record or doing anything beyond merely delivering the vehicles, the demonstration was of peculiar interest as showing the mechanical efficiency of a modern electric chassis and also the possibilities of the accumulator system even with the present limited charging facilities.

The distance travelled from the Company's works at Chelsea to York was 249·1 miles, the route taken being *via* Hertford, Bedford, Kettering, Leicester, Derby, Nottingham, Mansfield, and Doncaster, with varying types of roads and few stretches of level country. The average speed for the whole journey was 8·85 miles per hour, with 6·36 average ampere-hours per mile, the average watt-hours output from the battery per ton-mile being 120.

As will be seen from the illustrations, the York type of omnibus has a neat appearance and is of the "one man" single deck type, with seating accommodation for 22 passengers. The chassis frame is constructed of channel section pressed steel, in-swept in front to gain a wide steering lock and braced by strong cross members and gussets.



Elevation and Plan of Edison Accumulator Omnibus for York Corporation.

Both axles are solid drop forgings of special heat-treated steel, the front being I section and the rear of rectangular section. The suspension is by means of half elliptic springs of special silico-manganese steel, the front being 38 and the rear 46 ins. long. The steering gear is of the double worm type totally enclosed. This is operated by an 18 in. hand wheel mounted upon an inclined post which also carries the controller and reversing levers. The transmission is by propellor shaft from the motor to the differential bevel lay shaft, and thence to the rear hubs by roller chains totally enclosed in steel casings.

The brakes are of the equalised internal expansion type with Raybestos facings acting upon drums mounted on the rear wheels and countershaft respectively; these are operated by foot pedals, the rods being so arranged that a straight pull is given. The wheels, which are of the artillery type with cast steel centres, are fitted with Timken roller bearings.

The motor is of the series wound four pole enclosed traction type, with the shaft running on dust proof oil retaining ball bearings, the commutator being of extra large diameter and width. The brush gear is specially designed for easy replacement of brushes, which are of carbon faced with copper. The accompanying plans clearly indicate the general arrangement of the equipment, and from this it will be seen that the controller is located under a hood in front of the machine in an easily accessible position. This latter is of the continuous torque drum type, giving five speeds forward and two on the reverse. The contact fingers are of heavy section, and are easily renewable. The controller is operated by a lever situated on the left side of the steering column.

The battery consists of 64 Edison A 8 type cells of 300 ampère-hour capacity at 65 to 70 volts, the output being 22 to 25 KW.H. The weight of the battery is 1,900 lbs.

The system of wiring is shown and the plan of the body, which also shows the seating arrangements. All leads are as short as possible and of large section; they are securely supported where necessary by fibre clips or are carried in conduits, the ends being provided with taper terminals anchored with set-screws.

The bodies, which were built by E. & H. Hora, Limited, of Peckham, to the designs of Edison Accumulators, Limited, have a handsome appearance and are well constructed of selected materials. The bottom framework is of seasoned oak while the vertical standards and pillars are of well-seasoned ash, as also the cant rails. The side panels are of mahogany and the rear corner panels are of hand-beaten steel. The body is built on rocker sides with accommodation for the accumulators in boxes underneath the seats.

A special feature in the design of the body is the folding door which enables the driver to have complete control of the entrance to the vehicle. Reference to the plan will show that the entrance is on the near side of the driver, as it is intended to work the 'buses on the "pay as you enter" system. A glass window is placed just inside the entrance, through which the fare is passed into a fare-collecting device. A trigger is moved by the driver as each penny is deposited, and this movement automatically registers the fare and also allows the money to fall into the receptacle beneath. The door, which is made in two sections, folds up into a very small space and is operated by a lever placed above the driver's head. Special attention has been paid to ventilation, so that in addition to the ventilators which are fitted over each window, the windows themselves, both at the back and sides, are all fitted into mahogany frames and made to let down. The driver's seat is partitioned at the rear and sides, the sides being each fitted

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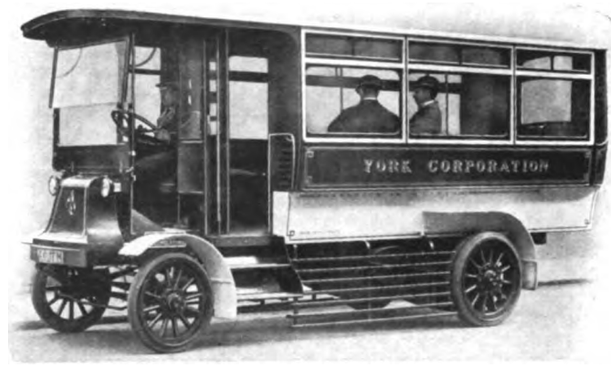
MOTOR TRAFFIC.

with glass windows in keeping with the body of the vehicle. The seating arrangement, as will be seen from the plan, is of a somewhat novel character; each seat is upholstered with well-sprung cushions or squabs covered in handsome red Terry velvet, which together with the polished mahogany gives a very pleasing appearance.

Energy for lighting is taken from an auxiliary battery consisting of six Edison cells, type A 4, arranged in conjunction with a special switch, the use of which enables these cells to be put into circuit in series parallel with the main battery for regular charging, but disconnected when the main battery is being boosted. The interior lighting is by eight Mazda lamps of the special car lighting type; these are recessed in the roof, and while effectively lighting the vehicle offer no obstruction to the free movement of the passengers. The auxiliary battery is only used for the interior lighting, as the external headlights are operated from the main battery.

A feature of the York vehicles which embodies the latest practice of the Edison machines, is the new method of housing the cells which does away with the steel clips as heretofore used. The new method involves a steel knob electrically welded on to the cell container, which is housed within an insulated bush mounted in the side bearers of the crates. It is claimed for this method that it greatly improves the insulation of the adjacent cells. Attention should also be called to the arrangements for ventilating the boxes in which the crates of cells are housed in order to prevent accumulation of gases. Small sliding shutters are fitted under the rocker sides of the body, which can easily be operated as required.



Edison Accumulator Omnibus.

The speed at which it has been found the Edison vehicles can be most economically run is 10 to 11 miles per hour on good hard level roads, while from 40 to 45 miles can be run on a full charge. By a system of boosting, however, at terminals between trips, 100 miles per working day can easily be covered. In connection with intermittent boosting it is interesting to note that this can be done at the following rates with the Edison accumulator:—

Up to 5 minutes at 300 ampères.
,, ,, 15 ,, ,, 240 ,,
,, ,, 30 ,, ,, 180 ,,
Or for 1 hour ,, 120 ,,
(approximate voltage being 115 in each case).

The total weight of the York type omnibus, including 22 passengers and the driver, is five and a half tons.

In each of the districts where Edison accumulator vehicles are running, complete satisfaction appears to be given, and at the present time when the labour question is of considerable importance, the type of omnibus here described should appeal particularly to Corporations desiring to commence a service with a few machines on well-populated routes where it is desired to experiment as to the advisability of employing power-propelled passenger traction. The employment of a driver in a dual capacity enables a considerable economy in wages to be effected, whilst detracting hardly at all from the service speed able to be maintained.

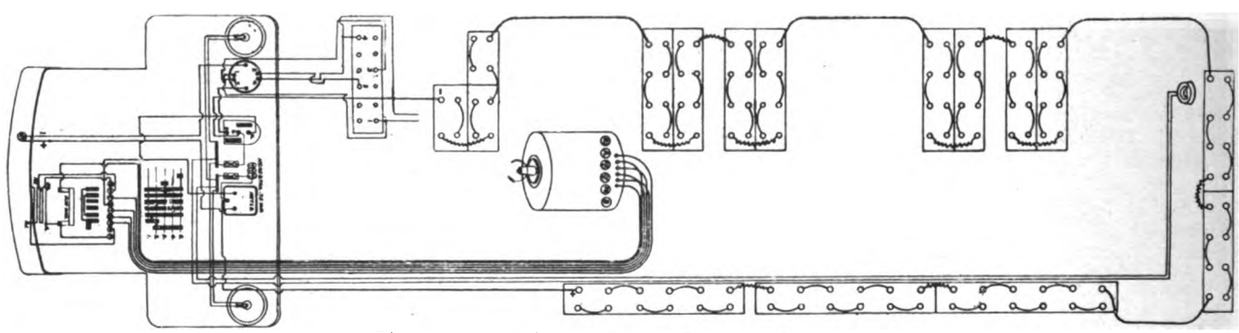


Diagram of Wiring of Edison Omnibus for York.

THE ELECTRIC VEHICLE.

The second number of the official journal of the Electric Vehicle Committee is strictly practical and businesslike in every item. An article on "Central Stations and Electric Vehicles" contains an interesting programme for central stations, with a view to promoting the use of the electric vehicle, which may be summed up in the adage, "When you get hold of a good thing, do not keep it to yourself." Mr. F. Ayton, M.I.E.E., in "Central Stations and Electric Vehicle Progress," gives a short account of the progress of the publicity campaign begun in October, 1913. Another article, "Pioneer Work in Electric Vehicles," by Mr. W. H. L. Watson, shows how the central station engineer can help forward the business, and is an excellent lesson on the larger aspects of salesmanship. "A Successful Electric Tower Wagon" and "Electric Vehicles for Electric Supply Undertakings" are articles which contain particulars of vehicles already in use, and illustrate clearly the utility of electric propulsion. In the latter we find some facts of special interest. The electric vehicle described was supplied to the mains department of West Ham Corporation, and consists chiefly of a standard one-ton chassis fitted with a plain flat body carrying appliances for cleaning street lamps, emptying flooded culverts, and other emergency work. A short table summarises the work performed by this vehicle in 36 days, and its cost:—Working days, 36; total mileage, 571·5; total hours running, 84; total number of journeys made, 353; maximum number of miles run in one day, 26; minimum number of miles run in one day, 8; average journeys per day, 15·8; average consumption of electrical energy (D.C input to battery), ·316 kw. This, at the rate of 1d. per unit, is equivalent to a cost of less than one-third of a penny per mile. Another interesting development of electrical enterprise is described by the writer of "A Wayside 'Refresher' for the Electric Vehicle," who shows, with the aid of photographs, a Hay's Wharf electric vehicle receiving a boosting charge at the electricity works of Croydon Corporation. "An Overload Detector for Electric Vehicles," by R. Rankin, B.Sc., shows that the want long felt for some means of checking the consumption of power on electric vehicles has been met. The instrument seems to be both simple and efficient. Altogether, the "Electric Vehicle," is a publication of value to everyone interested in the extension of the uses of electricity, and as the protagonist of a method of traction which has undoubted capacity for useful service we wish it patience, endurance and success.

Tramway and Omnibus Competition in America.—It is reported that American tramway undertakings are feeling the stress of omnibus competition so keenly that a movement is on foot in some of the larger towns to bring the omnibuses under the same taxation as is borne by the tramways.

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MOTOR TRAFFIC.

HEAVY MOTOR VECHICLES AND DAMAGE TO ROADS.

A Government Inquiry.

In view of the complaints which have been made as to the alleged excessive damage caused to roads by certain classes of heavy motors and locomotives, the president of the Local Government Board has appointed a small expert committee to inquire into the sufficiency of the existing requirements with respect to the construction of these vehicles, including weights on wheels, width of tires, the diameter of wheels, etc. The terms of reference are "to consider the law and regulations relating to the construction and use of road locomotives and heavy motor cars in Great Britain, and to report what amendments, if any, are desirable."

The committee will consist of Mr. E. Shortt, M.P. (chairman), Mr. A. G. G. Asher (secretary of the Association of County Councils in Scotland), Mr. P. M. Crosthwaite (Local Government Board engineering inspector), Mr. H. H. Humphreys (technical adviser to the National Traction Users' and Manufacturers' Association), Mr. E. J. Lovegrove (borough surveyor of Hornsey), Mr. J. E. Thorneycroft (former vice-president of the Society of Motor Manufacturers and Traders), and Mr. J. Willmott (county surveyor of Warwickshire), with Mr. R. J. Simpson, of the Local Government Board, as secretary. It is understood that a joint select committee to consider questions relating to contributions by motor omnibuses to the cost of road maintenance is also contemplated.

HALLEY'S FLYING CORPS.

We are indebted to Halley's Industrial Motors, Limited, for the photograph received from an officer at one of the British bases in France. This officer, who is in charge of the stores for Halley's parts in France, writes that to familiarise the men, who are entirely ignorant of mechanical transport, with the names of the various Halley parts and to train them to handle the parts, they have constructed a dummy chassis which is shown in the accompanying photograph. This was

Halley's Flying Corps.

put together in their stores from Halley parts, the frame consisting only of two wooden planks. This ingenious way of familiarising men with the various parts without taking away a complete vehicle from doing its usual and proper service seems to have been in every way successful, for the men forming the group on the chassis, who are all occupied in connection with the stores for Halley vehicles, are now quite familiar with the work.

Construction of Croydon Motor Road Postponed.—It has been decided that the construction of the new motor relief road between Thornton Heath and Purley, by which the narrow and congested main street through Croydon will be avoided, shall not be proceeded with until the war is over. The Road Board, however, has authorised the Croydon Borough Council to acquire the necessary land and enter into agreements for the erection of new railway bridges at Epsom Road and Waddon Marsh.

The Roads Improvement Association will hold its annual meeting at the Institution of Civil Engineers, Westminster, S.W., on Thursday, April 22, at 4 p.m. The Hon. Arthur Stanley will preside.

ELECTRIC VEHICLE CHARGING STATIONS.

STANDARD SIGNS.

We learn that the General Electric Company, Limited (67, Queen Victoria Street, London, E.C.), have been appointed official manufacturers to the Electrical Vehicle Committee of the standard design of illuminated box sign for charging stations and for garages where charging facilities are provided. The sign, wired complete, with terminal box and arranged for bolting to the face of a wall or to be supported by the usual type of bracket, is made in four standard sizes. The two standard sizes, 30 in. square and 18 in. square, each side with either a single or double face, are those recommended by the Electrical Vehicle Committee.

The frame and case of the sign are of best quality stove enamelled iron, black outside and white inside, of ample and substantial gauge, which varies with the size of sign. The panels are of best quality duplex glazing, formed of a front sheet fired with red and white permanent colours, backed by a sheet of clear glass suitably attached. The advantages of this method of glazing are, bright colours which show well both by day and night, strength, and smooth surfaces on both sides of panel, which keep clean longer and are easily cleaned. This sign is the subject of a leaflet (No. F 1887) of the General Electric Company, Limited. The full range of sizes there listed is:—Swing pattern, with rings for suspending from bar or bracket, 24 in. and 30 in. square; post pattern, with wrought-iron clips for clamping end-on to lamp-post, 12 in., 18 in. and 24 in. square; end-on wall patterns, with backplate for screwing or bolting to wall, 12 in., 18 in. and 24 in. square; flat-on wall pattern, with lugs for screwing or bolting to wall, 24 in. and 30 in. square.

SOUTHAMPTON AND OMNIBUSES.

The traffic manager of Southampton Corporation Tramways in reporting some time ago on the question of running motor omnibuses in conjunction with the tramways, put the average cost of motor omnibus working at 10d. per mile. Taking the costs of running expenses in six towns, in various parts of the country where omnibuses had been in use, Mr. Simpson found that they varied considerably; but with modern double-decked vehicles it would appear to be about 10d. per 'bus-mile. To compare this with the cost of running the Corporation tramcars, Mr. Simpson put the average costs per car-mile for the last three years, including traffic and general expenses, repairs and maintenance, cost of power, interest on and repayment of capital, etc., at 9·42d. per car-mile. To this he added the average cost of all renewals (chiefly relaying of track) for the last 10 years, which equals 0·570d. per car-mile, thus making the total cost 9·99d., or, say, 10d. per car-mile. The net result is that it would cost exactly the same, 10d. a mile, to run a double-decked petrol 'bus with a seating capacity of 34 as it did to run a tramcar with a seating capacity of, say, 56. Assuming that each vehicle ran an average of 30,000 miles per annum, the cost per seat per annum for running the tramcar would be £22, and for the motor 'bus £36. The difficulties of dealing with rush traffic on a wet day would necessitate a large fleet of spare 'buses, which would only be used for two or three hours daily, and it would be a serious matter if 'buses were substituted for trams in Southampton, as many more miles would have to be run to earn the same revenue, with a consequent reduction, if not an entire loss, of profits. It is on these grounds that Mr. Simpson based his opinion that the tramcar is still the most suitable vehicle in a provincial town like Southampton, and that there are no substantial grounds for assuming that it will shortly be ousted from its place by the motor 'bus. When the 'buses are used as a feeder to the tramways, Mr. Simpson is of opinion that the case is very different, and that in this respect the 'buses would prove to be a valuable asset.

A New British 4-ton Chassis.—A well-designed British-built chassis suitable for loads up to 4 tons has just been placed upon the market by Palladium Autocars, Limited, of Filsham Road, Putney. The machine, which embodies a number of interesting details, is fitted with a 40 H.P. engine with the cylinders cast in pairs and mounted on the three-point suspension principle. A single camshaft operates the water pump and also the self starter and lighting set. A four-speed chain-driven gear box with aluminium case is also supported at three points. The final drive is by worm wheel of the overhead type. Leather universal joints of large size are a feature of the chassis.

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MOTOR TRAFFIC.

MOTORS FOR MUNICIPAL SERVICE.

The steady demand for motor vehicles by municipal authorities for their various public services continues. Amongst the latest movements in this direction are the following :—

Aberdeen Town Council have under consideration the purchase of another fire engine.

The Belfast Board of Guardians have decided to purchase a new motor ambulance.

Sunderland Corporation have decided to purchase a new motor fire engine at the cost of £500.

Devon County Council have decided to purchase 2 steam tractors for use in the Highways Department.

The Bromley Board of Guardians have decided to purchase a motor ambulance at the cost of £550.

Hull Corporation have decided to spend £2,700 on the purchase of motor vehicles for service in their Health Department.

Rochester Corporation have decided to purchase a motor fire engine and invite tenders from a number of selected firms.

Nottingham Corporation have decided to add to their fleet of motor fire engines. It is recommended that two further machines shall be purchased.

Malvern Urban District Council have placed an order with N. and B. Woodyatt, Limited, for the supply of 2 motor cars for the use of the Council.

Yeovil Corporation have decided to purchase a 5-ton chassis fitted with an interchangeable tipping body and water tank with capacity of 1,000 gallons.

Deptford Borough Council have decided to place an order with Leyland Motors, Limited, for the supply of a watering van fitted with pressure distributors.

Tottenham Urban District Council have placed an order with D. Napier and Sons, Limited, for the supply of a motor ambulance fitted with electric lighting set.

The Skipton Board of Guardians have placed an order with the Yorkshire Commercial Car Company, Limited, for the supply of a 3-ton steam wagon fitted with a tipping body.

Altrincham Council have decided to grant licenses for the running of motor omnibuses between Altrincham and the surrounding districts to the British Automobile Traction Company, Limited.

Ealing Urban District Council have accepted the tender of Mann's Patent Steam Cart and Wagon Company, Limited, for the supply of a 5-ton steam lorry fitted with interchangeable tipping body and a 1,000 gallon water tank.

The Metropolitan Asylums Board have accepted the tenders of the Avon Rubber Company, Limited, Shrewsbury and Challiner Tyre Company, Limited, and the Dunlop Rubber Company for the supply of tires for their various vehicles.

Bradford Corporation have decided to purchase a 3-ton steam wagon from the Yorkshire Steam Wagon Company, Limited, for use in the cleansing department, the machine to be so fitted that it will be suitable both for watering and street sanding.

Sheffield Corporation have decided to purchase for the use of the Health Department a motor van which may either be of the petrol or electric type. Tenders are invited for this and should be sent to the Health Superintendent, Town Hall, Sheffield.

Weybridge District Council have taken delivery of a petrol motor fire engine from Messrs. Merryweather, Limited. This machine is of the Hadfield type with pump to deliver 250 gallons per minute, discharging through four jets simultaneously.

Teddington Urban District Council have failed to obtain the consent of the Local Government Board to borrow money for the purchase of a motor fire engine. The reason for withholding their sanction is that they do not consider that the present time is opportune for obtaining the money.

The Chiswick District Council have reconsidered their decision arrived at at the previous meeting of the Council with regard to the purchase of four motor vehicles for service in their cleansing department. It is now proposed that only two machines shall be purchased, and the question of electrically propelled vehicles is now being considered by the Council.

Hove Town Council have granted 12 licenses to Messrs. Thomas Tilling, Limited, for the running of that number of Tilling-Stevens petrol electric omnibuses within the district. We understand that a number of these are now in service, but owing to the fact that the Brighton Corporation will not grant licenses for these vehicles, the service terminates at the Brighton boundary.

MOTOR MANUFACTURING COMPANIES.

Straker-Squire (1913), Limited.—Mr. Sidney Straker, presiding at the first annual ordinary general meeting of Straker-Squire (1913), Limited, on Wednesday, said that the directors' report showed a net profit for the year under review, after providing for all expenses, including depreciation, of £20,432. The company had had to contend with great difficulties during the early part of the period, and in the latter part there was disruption of business owing to the war. In the circumstances they must consider the result as particularly gratifying. He looked forward to the future with every confidence, as the company was in a sound financial condition, having all its capital subscribed. Their Twickenham works had been put in a satisfactory condition, and their revenue had increased to the extent of £90,000. At the time when the capital of the company was arranged, it was not contemplated that these works would be purchased and paid for out of the funds in question, so that it was gratifying to know that at the end of the year the company had a cash balance of over £11,000, and had likewise paid for the works. They had two departments—the pleasure car and the industrial department. The outbreak of war had materially affected the sales of pleasure cars, but that trade was now improving, and there was every prospect of a fair business very shortly, although much would depend on the duration of the war. They had something up their sleeves in the shape of a new model car. The chassis of that car was the result of considerable experience, and was likely to create the keenest interest among motorists, as it would give the public a first-class article of great durability. The precise period when the car could be produced would depend upon the duration of the war, but when the time came they were assured of a good market. When the war broke out, the War Department commandeered all the machines they had in course of manufacture, and no machines could be delivered to any private customer. That was the position to-day. They were simply supplying the Government. The position was to some extent prejudicial to them, but they were serving the country and were naturally anxious to do the best they could in this way. Material required for manufacture was most difficult to obtain, owing to the large orders placed by the War Office and the Admiralty for munitions of war. They were also finding it difficult to maintain their staff. The directors had gone far to develop Colonial and foreign business, and their commercial lorries possessed an excellent reputation.

Edison Accumulators, Limited.—Mr. B. M. Drake, presiding on March 19 at the meeting of this company, held at the offices at 2, Duke Street, S.W., said that the results were fairly satisfactory, allowance being made for the abnormal times through which they were passing. The item under profit and loss account for staff, offices, and selling expenses might appear high, but in initiating the industry of the company, which was new to this country, it was necessary to be constantly running cars for demonstration purposes. In order to obtain the concession for the sole rights of the Edison battery for England the sum of £5,000 had been paid in advance. This amount was, however, being credited to the company as orders were placed with the Edison Company of America. At the end of the year there were sufficient unexecuted orders on the books to enable them to show a profit had it been possible to obtain the necessary equipment in time. Encouraging reports were being received of the results obtained from vehicles now at work. The cost per ton mile compared favourably with that of other road transport systems, and the reliability, easy manipulation and quiet running of the Edison vehicles were proving to be advantages with which no other system could hope to compete. The cost of generating and supplying current was steadily diminishing, whilst the cost of petrol and other fuel had been continually rising. One borough council engineer had found that four two-ton tipping wagons had replaced no fewer than 11 horses and carts, besides doing the work of refuse collection more efficiently. Although the first cost was heavier, it was claimed for the Edison battery that it could withstand successfully vibration and hard work which would shorten the life of lead batteries, so that in the end the cost for traction work would be lower. The orders received since the expiration of the period covered by the balance-sheet had been most satisfactory; in fact, they amounted to over three-fifths of the total orders received during the previous year.

Associated Omnibus Company.—Presiding at the annual general meeting in London, on March 29, of the Associated

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MOTOR TRAFFIC.

Omnibus Company, Mr. H. Byrne said the net profit for the past year was only £85, compared with £198 in the previous year, but this amount was arrived at after allowing £360 for depreciation and dilapidations, so that the actual results were better The chairman's statement and the management were severely criticised by several shareholders, and a demand was made that the company should be wound up. On the chairman putting the motion for the adoption of the report, a majority present voted against the motion. The chairman, however, said that by virtue of proxies which the directors held the report had been adopted. The motion for the re-election of the chairman as a director and for the re-election of officers met with the same opposition, but the chairman declared both motions to have been carried.

MOTOR OMNIBUS IN A MARCH SNOWSTORM.

The difficulties encountered by the motor omnibus on the roads in winter are vividly portrayed in the three photographs reproduced on this page. These views show the plight of one of the motor omnibuses of the Newcastle Corporation Tramways in a heavy snowfall in the latter part of March, when the vehicle was snowed up about three miles from the city. The omnibus reached that point with some difficulty, and the snow fell so rapidly that it was impossible for the return journey to be made. Word was sent to headquarters that the omnibus was held up and a snow-plough was despatched to its assistance. The plough stopped, however, about half-a-mile from the stranded omnibus. The vehicle remained in the snow all night and presented a lone and desolate appearance in the morning, as may be seen in one of the photographs. The omnibus was soon dug out, the road cleared and the snow banked up high on both sides.

The Scene in the Morning.

The Road Cleared.

MOTOR TRAFFIC NOTES.

The Dunlop Gauge.—The Dunlop Company are putting on the market a new pressure gauge at 5s. each, for use with pneumatic tyres.

Leyland Dividend.—The dividend on the ordinary shares of Leyland Motors, Limited, for the past year is 2s. per share, free of income tax, the amount carried forward being £28,252.

Commercial Vehicle Committee.—Mr. W. D. Williamson, of Walker Brothers (Wigan), Limited, was at the last meeting of the Commercial Vehicle Committee of the Society of Motor Manufacturers and Traders elected to a seat on the committee.

Petrol-driven Omnibuses for Walsall.—The Tramways Committee of Walsall Town Council recommended the purchase of six petrol-driven electric motor omnibuses, at a cost of £5,545. At the meeting of the Council, held on March 8, the recommendation was approved.

Mr. Leo Swain, of Manchester, has entered into an arrangement with George Spencer Moulton and Company, Limited, for the purpose of establishing a solid tire branch of the Spencer Moulton business. The business of Messrs. Leo Swain and Company will be continued as usual, but Mr. Swain will become general manager of the tire department of the Spencer Moulton Company.

Clearing Away the Snow.

Patriotism of London Drivers.—In reply to a question in the House of Commons, Mr. H. J. Tennant, secretary to the War Office, stated that the men employed in the London public carriage service had not been lacking in public spirit, about 20 per cent. of their number being in the service of the Crown. The large omnibus companies had given all reasonable facilities to the men.

Proposed Petrol-driven Cars.—At the recent monthly meeting of the Bridge-of-Allan Town Council, a letter was read from Mr. A. M. Wardlaw, secretary of Stirling and Bridge-of-Allan Tramways Company, requesting consent to a provisional order promoted by the company for the permanent working of the system by means of petrol-driven cars. The Council decided to hold over the matter for further consideration.

Motor Vans for the London County Council.—At a recent meeting of the London County Council it was decided to dispose of all the remaining horses in the tramway department and to employ motor vehicles for the transport work hitherto carried on by horses and vans. The Highways Committee propose that for the time being the work shall be done by contract and that tenders shall be invited from selected firms. The Council approved of the scheme.

Bradford Corporation contested a claim for £98 damage to a steam wagon which was alleged to be the result of the faulty filling up of a hole in the roadway after the removal of a tramway standard in Horton Bank. His Honour, Judge Grantham, K.C., however, held that the hole had not been filled and rammed by the Corporation employees in such a manner as to render the roadway sufficient to carry the traffic and that this amounted to negligence. He therefore gave judgment against the Corporation.

The Ledworth Rural District Council have failed in their endeavour to place the responsibility for the up-keep of the road upon

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MOTOR TRAFFIC.

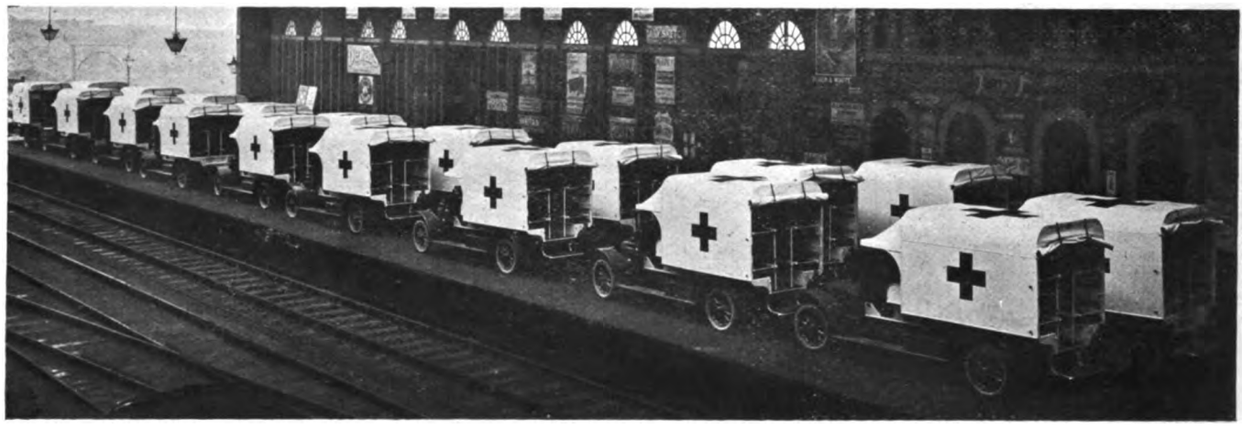
the road users. Their contention appears to be that when once a road has been placed in a proper condition, the motor traffic which they regard as of an unusual character should be liable to the repairs of the road which now fall upon the local authority. The case came before the Court of Appeal and has been decided against the Council.

Speed Limit of Motors in India.—Under the Bengal Motor Car and Cycle Act of 1903, the speed limit for heavy motor cars with non-resilient tyres was 3½ miles per hour. The Indian Motor Vehicles Act of 1914 repealed the former Act, but the speed limit was retained. On representations being made to the Bengal Local Government, however, the speed limit in Calcutta for heavy motor cars with non-resilient tyres has been raised to 5 miles per hour.

Motor Drivers at the Front.—The following extract from a letter written by a correspondent at the front gives some idea of the methods which obtain amongst some of the motor transport drivers: Some plucky things have been done by chauffeurs and motor lorry drivers. It would make some of your London drivers stare to see what they will risk. One of them said this war will cause a revolution in motor driving, as till now they never had a chance of seeing what a heavy motor van could do off a macadamised road. They simply go wherever there is room for them, and more than once they have charged patrol parties who tried to capture them, and got through all right. One driver, seeing that the road was blocked, charged a wooden fence and turf wall, and got out of the way of a lorry that the Germans sent at full speed to smash him. The smashing was on the German lorry.

"Commer Car" Lorries—A Week's Output for the War Department.

Government Take Over Scottish Motor Works.—The Scottish motor companies have been taken over by the Government, and the whole productive capacity of the works will now be used for the manufacture of motor lorries for the transport department. The works are running night and day. It is stated that the great engineering works engaged in manufacturing munitions of war will remain under the control of the firms concerned.



Motor Ambulances Awaiting Shipment.—These Vehicles were Presented to the King by the Maharajah Scindia of Gwalior.

The Albion Motor Car Company have received a number of letters from the drivers of Albion vehicles now on active service in France and Belgium, all of which contain most gratifying reference to the excellent work that is being done by these machines and also testifying as to their reliability. When the large extension to the works at Scotstown, giving some 82,000 square feet additional floor space is complete, the company hope to be in a position to give reasonable delivery to the large number of their clients whose replacement orders are yet unfilled.

25 h.p. 2-ton Albion Lorry at Work in France.

War Office Recognition of Motor Workmen.—Leyland Motors Limited recently received a letter from the War Office which shows that the workmen engaged in providing equipment for the army are now recognised by the War Department as serving their country in this most important direction. The communication which they have received is as follows:—"I am directed to inform you that arrangements have now been made by which none of the men employed by you and engaged upon the production of goods for the War Department will be enlisted without your consent. Recruiting officers concerned have been instructed to this effect, and any man presenting himself for enlistment who is known to be employed by you will be refused without the sanction mentioned."

Burford Lorries.—The sole selling rights of Burford Lorries which until recently have been held in this country by the Automobile Consolidated Alliance, Limited, of Albemarle Street, London, W., have now been taken over by Messrs. H. G. Burford and Company, whose head office is at 11, Waterloo Place, S.W., with works at South Row, North Kensington. Mr. H. G. Burford is at the head of the new company, and will devote his undivided attention to the development of this business. As Mr. Burford may justly claim to be one of the pioneers of the motor vehicle industry and is a past chairman of the Commercial Vehicle Committee of the Society of Motor Manufacturers and Traders, his experience and knowledge of the requirements of motor vehicle users specially fits him for the direction of a company whose business will be the supply of industrial vehicles for all purposes. We understand that the working of the two-ton machines already supplied has been so satisfactory that repeat orders are now being received.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

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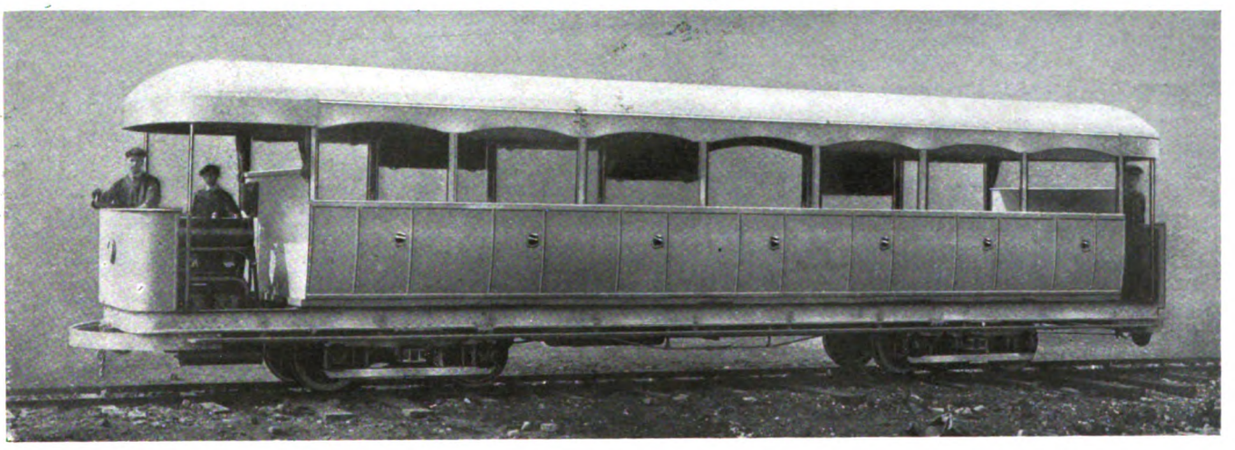
SIMPLEX PETROL RAIL CARS FOR INDIA.

Three railway cars of a novel type, driven by petrol engines, have been built to the order of the South Indian Railway Company by the Motor Rail and Tramcar Company at Phœnix Iron Works, Lewes. Their propelling machinery is of the same type — the "Simplex"—as that which has been so successful with tramcars at Karachi; much therefore may be expected of the new vehicles. They have been obtained in order to relieve the railway company's shuttle service and to provide a more frequent one between Trichinopoly and Trichinopoly Fort, Negapatam and Nagore, and on the new Pambam Viaduct.

The new coaches are described as 70-passenger petrol-driven "Simplex" rail cars, and their arrangement may be gathered from the accompanying illustrations.



Simplex Petrol Rail Car for India.

The coach is designed for a maximum speed of 25 miles per hour loaded with 70 passengers, operating on petrol fuel of a density of ·760° to ·780°, known as benzine.

The principal dimensions are as follow:—

	Ft.	in.
Overall length over buffer fenders ...	42	6
Length over headstocks	40	0
Length over corner pillars ...	31	10
Bogie centres	22	0
Bogie wheel base	5	0
Gauge	3	3⅜ (1 metre)
Maximum width	8	6
Overall height	10	6
Capacity	70 passengers	
Weight in running order	11 tons 10 cwt.	

The underframe is constructed in the usual way of rolled steel sections (which were all previously tested by the South Indian Railway Company's inspectors), suitable bracing and tie bars being employed to prevent any possibility of the frame becoming out of square through shunting or other rough handling. This is necessary, as the frame is so constructed as to receive the various components of the propelling machinery, which will be described later.

The underframe is mounted on two exceptionally compact bogies of the floating bolster type. The bolsters are mounted on a combination of laminated plate springs and the usual helical springs of round section steel. These springs are mounted "in series" and not "in parallel," if the electrical expression may be used. That is to say, all the vibration must pass through both the laminated and the helical springs before getting to the framework. The trials conclusively proved the efficiency of the design in this respect.

The propelling mechanism is mounted upon the main frame. The engine, which is of the latest 4-cylinder Otto cycle type, develops 45 B.H.P., and is fitted with totally enclosed valves. The governor cuts out at 1,500 revolutions per minute, and is so arranged that it is quite impossible for the driver of the coach to alter the setting. The lubrication is absolutely automatic, the oil being forced round the bearings and through a drilled crankshaft, and then back to the sump, where it is automatically strained before being pumped round again. The ignition is by the Bosch high-tension magneto only, which the Motor Rail and Tram Car Company consider quite sufficient, this being the 50th "Simplex" rail vehicle that they have constructed on this system. The system of water cooling is also backed by the same experience. The water is led through a series of copper tubes arranged in such a manner that there is not a single brazed or sweated joint in the whole circuit, and yet the amount of cooling

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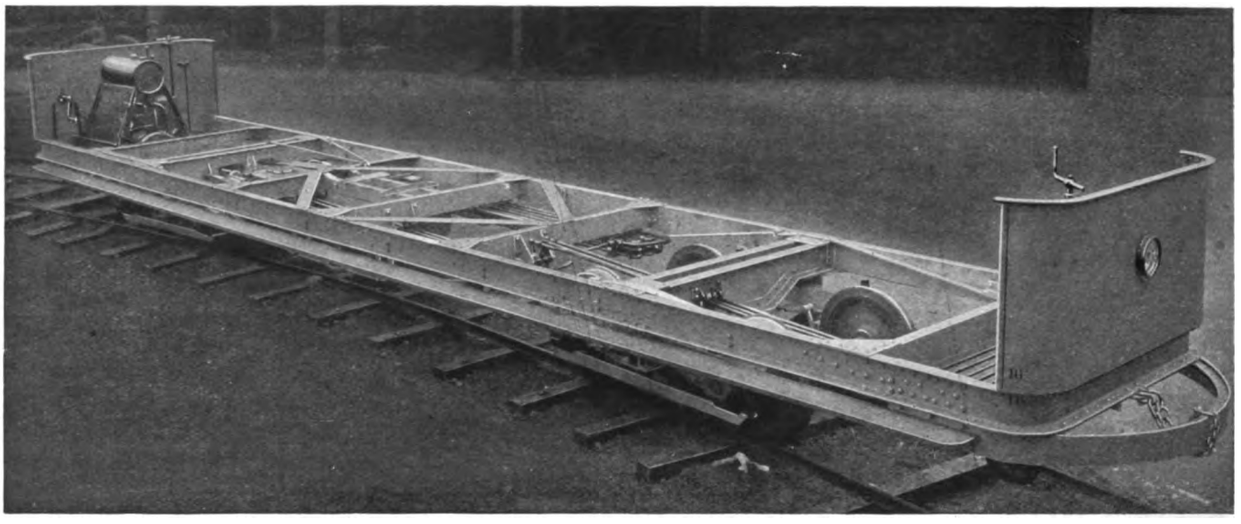
area can be adjusted to suit climatic conditions in a very short space of time. The fuel is stored in a galvanised tank situated beneath the car so as to be out of the powerful rays of the sun in Southern India. The tank is pressure fed by a small air pump driven off the camshaft which maintains a pressure of 3 to 5 lb. per sq. in., and is provided with a release valve should that pressure be exceeded. The fuel is led from the tank through a fine gauze strainer to a standard Solex type carburetter, which, as is well known, is capable of a very large amount of adjustment to suit varying climatic conditions by means of interchangeable chokes as well as main and auxiliary jets.

The power developed by the engine is transmitted through an exceptionally heavy flywheel in which is contained the friction clutch to the change-speed gear-box, and thence to the road axle by means of a "D.B. and S." type worm gear. Taking the details of the transmission in order, the friction clutch, which is of the inverted type, is arranged practically within the flywheel, and is lined with bonded "Ferodo" working on hard bronze, which is in turn arranged with "counter" or engagement springs working against the main springs of the clutch. The result of this is that exceptionally easy engagement is effected with a minimum amount of shock both to passengers and engine.

The gear-box (which is constructed under the "Dixon-Abbott" patents) affords three speeds in either direction, or six speeds in all, and is of exceptionally stout and compact design. One of the features is that the case is so constructed that engine oil may be employed for its lubrication instead of thick grease, thereby considerably adding to its efficiency, while the gears, which are very broad, are case-hardened and ground to ensure silence.

The power is then taken to the worm gear by a shaft with sliding block type universals at each end and is held in position by steadying springs concealed within the universal. The worm itself is mounted on ball journal bearings, and the thrust taken up on double ball thrust bearings, while the worm wheel is mounted and keyed on to the road axle itself, and the casing, which completely envelops the whole, is also mounted on the axle, running on phosphor bronze bushes and lubricated from pockets of oil inside the casing, which is kept constantly filled by the action of the worm wheel, which, of course, runs in oil and is completely enclosed. The silence of the transmission on the trials was almost as notable as the absence of vibration of the engine, which we are informed was due to the special design of the crankcase and to the fitting to the framework.

The efficiency of this drive through spur gears (no bevels are employed) running in a bath of light oil, and one of Messrs. David Brown & Sons' latest type worm gears, also running in oil, compares, it is claimed, very favourably with the electric and hydraulic transmission at times attempted. The worm gear, or its equivalent, must in all cases remain to transmit the power finally to the road wheel. It therefore appears that the electric dynamo and motor, or its equivalent, to convert mechanical energy into electrical and then reconvert back to mechanical energy at slower speed, with its inherent power losses, only replaces the spur gearing running in oil, which it must be admitted is one of the most efficient forms of transmission known. This may be the reason for the almost universal use of the once-termed "brutal" change-speed gear in the automobile world. In any case, this is another example of what can be achieved on these lines when due care is taken to give sufficient "overlap" of gears with respect to the high and low limit speeds at which the engine can be satisfactorily run. It may not be out of place to point out that, owing to the lower rolling friction on rails, more time may be safely taken in the operation of gear changing, and the operation becomes materially easier instead of harder in rail vehicles.



Underframe and Bogies of Simplex Rail Car.

The control of the rail coach is effected from either end at will, removable levers being dropped into sockets by the driver, in whose possession these levers always remain. The levers consist of the throttle or regulator which controls the speed of the engine, the change-speed lever, and the reverse lever, the latter, of course, only being used at the termini. These are all mounted on a neat aluminium quadrant. The clutch-operating pedal and standard screw brake complete the control.

The body has been designed to meet the special conditions and to come within the Government of India maximum moving dimensions for metre-gauge railways. Being designed for third class traffic, teak wood slat seats are provided. The usual side entrance doors and footsteps are used. The floor is entirely of teak, while the sides are a combination of steel and ash panelled with steel plate and metal mouldings. There are no windows, as the climatic conditions do not require it, but weatherproof sunblinds are provided all round. The roof is of the usual pitch pine slats covered with stout canvas laid on in thick white lead. The roof and

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end canopies are designed to have a sightly appearance and at the same time to give a minimum area for wind resistance, and, as the illustration shows, these ends appear to have been achieved.

The complete rail coach has been designed by the engineer to the Motor Rail and Tram Car Company, of 79, Lombard Street, London, E.C., Mr. J. D. Abbott, who is also consulting engineer to the East India Tramways Company. This latter company, it may be noted, operates a large fleet of "Simplex" tram cars with great success, as they are specially adapted to tropical requirements and to the taste of the crowd of natives attracted by their arrangement, and by the lowness of the fares it is possible to charge owing to the small cost of working this type of car.

The South Indian Railway Company in this departure from standard railway practice are not only giving the public a more frequent service, but realise the old axiom that frequent services increase traffic receipts. We would welcome greater enterprise in the same direction, especially for light traffic, on the part of some of the railways and light railways at home.

ADELAIDE MUNICIPAL TRAMWAYS TRUST.

Tramway enterprise in Australia is comparatively young, but it advances with swift and long strides. In the city of Adelaide, from small and sporadic beginnings, the tramway system has developed into a series of routes running through the city and extending to the environs in every direction. At the present time there are 20 different routes. One route is over six miles continuous double track, and the whole service affords easy passage from any part of the surrounding district to any point in the city. The system contains 33·406 miles double track, 18·449 miles single track, 4·942 miles loops and crossings, and 2·387 miles standing roads, the whole being equal to over 92 miles of single track.

Up till 1907 the Adelaide tramways were in private hands, but in that year the whole enterprise was taken over by the Adelaide Municipal Tramways Trust, at a cost of £284,000. When it is stated that the capital now involved in the undertaking is over 1½ millions sterling, the great developments which have taken place under the management of the Trust can be readily appreciated. The total amount spent on construction work and debited to the revenue-earning portion of the undertaking is £1,359,013. The bulk of this large sum has been spent in converting the system from a horse-car to an electric-traction system, and subsequent developments. On March 10, 1909, the first electrified route was opened for traffic. During that year conversion proceeded at a rapid pace, six more routes being converted and completed between April and December. The year 1910 was not so prolific, one route only being opened during the 12 months; but in 1911 eight routes were made ready for passengers. Since that date, electrification and extension of the system has proceeded steadily, each year seeing a development. The only horse car now in operation runs on a small section, which it has not been found convenient to electrify. As a matter of fact, the horse cars have been statistically insignificant since 1912.

Accompanying is a diagram showing the fortnightly traffic returns since the inception of the Trust. It will be seen from the diagram what a vast difference the electrification of the system produced on the business of the undertaking. The years 1907-8 show only that difference which natural growth would make; but in 1909 the lines take a sudden upward curve. With minor fluctuations, the whole trend of the traffic is upward, increasing by thousands of pounds of revenue every year.

Another view of the growth and magnitude of the undertaking is given in the following table, showing the traffic receipts for the whole period between the inauguration of the system and July 31, 1914:

Six-Monthly Period.	Car-Miles.	Passengers.	Traffic Receipts.	Average Traffic Receipts per Car-Mile.
			£	d.
Mar. 10, 1909–July 31, 1909	522,565	4,654,382	33,862	15·55
Aug. 1, 1909–Jan. 31, 1910	1,199,556	9,937,631	70,259	14·05
Feb. 1, 1910–July 31, 1910	1,639,208	13,709,155	97,862	14·32
Aug. 1, 1910–Jan. 31, 1911	1,790,402	15,260,080	109,464	14·67
Feb. 1, 1911–July 31, 1911	1,829,820	16,085,496	115,020	15·08
Aug. 1, 1911–Jan. 31, 1912	2,287,946	18,538,383	135,552	14·22
Feb. 1, 1912–July 31, 1912	2,370,048	19,308,425	141,508	14·33
Aug. 1, 1912–Jan. 31, 1913	2,528,226	20,703,208	152,724	14·49
Feb. 1, 1913–July 31, 1913	2,612,480	20,873,275	153,557	14·11
Aug. 1, 1913–Jan. 31, 1914	2,670,835	21,822,237	161,660	14·52
Feb. 1, 1914–July 31, 1914	2,654,824	21,974,990	161,840	14·63

Excluding school tickets and special cars.

The management of the undertaking is vested in the members of the Tramways Trust and officers: Chairman, Alex. B. Moncrieff, C.M.G., J.P., M.Inst.C.E., etc.;

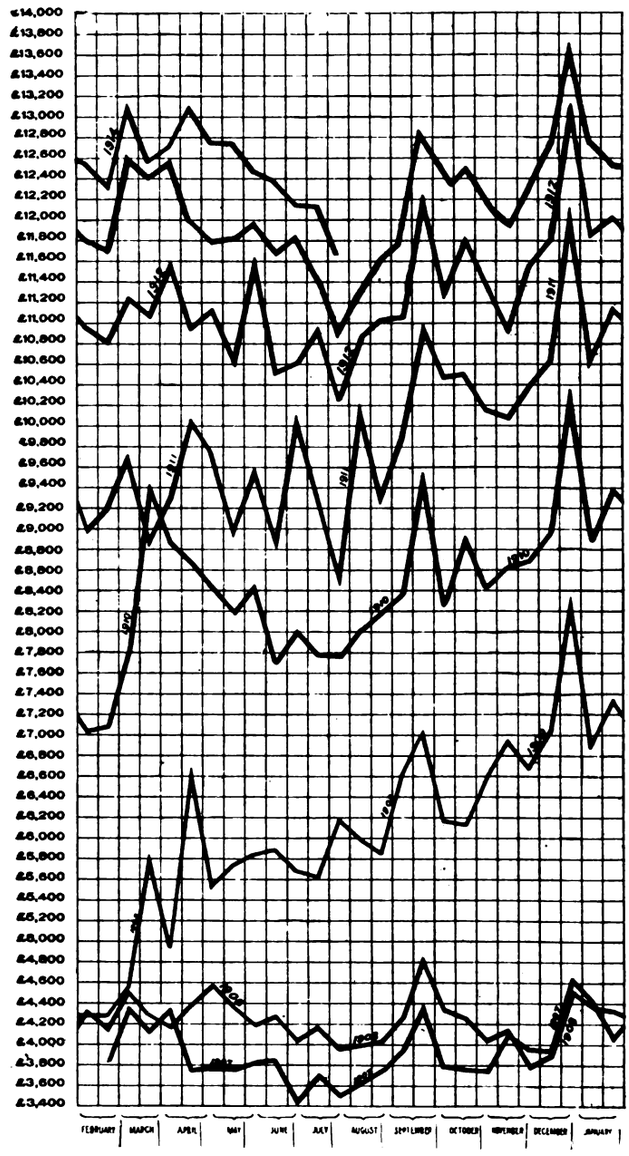

Diagram showing Fortnightly Traffic Returns since the Inception of the Trust.

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Revenue, Expenditure, Appropriation, and Balance from Inception.

Half-Yearly Revenue from February 5, 1907.

Half-Yearly Expenditure and Appropriation from February 5, 1907.

Including Interest on Inscribed Stock and Treasury Bills from December 19, 1906, to January 31, 1907.

Half-Year Ended	Horse Traction.		Electric Traction.		Bank and Other Interest and Discounts.	Total Revenue.	Percentage of Increase over Previous Half-Year.	Revenue per Car-Mile.	Expenses per Car-Mile.	Percentage of Operating Expenses to Revenue.	Total Operating Expenses.	Reserve for Renewals.	Appropriation Account. Interest on Purchase Money.	Interest on Advance for Construction	Sinking Fund.	Total Appropriation.	Total Expenditure.	Balance of Appropriation. * Deductions.
	Traffic Receipts.	Sundry Receipts.	Traffic Receipts.	Sundry Receipts.														
	£	£	£	£	£	£						£	£	£	£	£	£	£
July 31, 1907 ..	48,989	1,207	—	—	—	50,196		—	—	H. Trac. only 83·970	42,150	—	*0,240	..	—	6,240	48,391	1,805
Jan. 31, 1908 ..	53,143	1,420	—	—	—	54,564	8·700	—	—	88·359	48,212	—	5,326	..	—	5,326	53,539	3,854
July 31, 1908 ..	55,223	1,242	—	—	39	56,505	3·558	—	—	88·948	50,265	..	5,326	—	—	5,326	55,587	4,000
Jan 31, 1909 ..	55,822	1,166	—	—	43	57,032	933	Elec. Traction only		89·401	51,022	—	5,326	—	—	5,326	56,349	5,115
										E. Trac. only								
July 31, 1909 ..	37,782	922	33,862	102	14	72,684	27·442	15·59	10·82	69·387	63,193	1,000	5,326	2,763	—	9,089	72,283	5,232
Jan. 31, 1910 ..	18,352	1,530	70,259	259	43	90,445	24·437	14·10	9·74	79·033	74,192	2,343	5,225	7,208	—	14,837	89,030	7,663
July 31, 1910 ..	7,108	1,090	97,862	430	69	106,507	17·825	14·392	10·042	75·973	88,189	3,453	4,939	10,359	—	18,752	106,942	*5,499
Jan 31, 1911 ..	7,045	373	109,464	481	43	117,407	10·172	14·738	10·724	72·737	92,482	4,004	4,957	12,013	—	20,974	113,456	13,774
July 31, 1911 ..	6,386	501	115,020	459	29	122,397	4·249	15·146	10·613	70·055	92,520	4,896	4,812	14,869	—	24,399	116,919	20,778
Jan. 31, 1912 ..	1,918	255	135,552	821	72	138,619	13·254	14·305	9·123	63·742	92,696	6,324	4,790	20,524	—	31,049	124,345	43,848
July 31, 1912 ..	800	110	141,507	1,153	85	143,658	3·635	14·446	9·523	65·884	90,534	7,599	4,504	43,117	20,265	55,486	152,021	*12,850
Jan. 31, 1913 ..	—	—	152,723	1,599	88	154,411	7·485	14·610	9·664	65·928	101,800	8,063	4,475	24,250	21,328	58,118	159,919	*10,197
July 31, 1913 ..	—	—	153,557	1,762	509	155,829	·918	14·208	9·693	67·714	105,517	8,273	4,345	24,373	22,240	59,235	164,753	*2,216
Jan. 31, 1914 ..	—	—	101,666	2,059	386	104,106	5·312	14·712	9·119	61·836	101,477	8,500	4,406	25,729	22,508	61,153	162,630	9,731
July 31, 1914 ..	—	—	101,840	2,398	554	104,792	·424	14·859	9·133	61·338	101,026	8,424	4,326	25,587	22,650	60,988	162,014	2,688
Totals ..	292,573	9,821	1,333,310	11,444	1,979	1,649,129	—	—	—	—	1,201,277	62,893	74,340	190,676	108,096	430,997	1,638,184	10,944

members, Messrs. R. Cruickshank, Thomas Gill, H. J. Holden, I. Isaacs, F. B. Moulden, A. C. Sanders, H. Sherriff; chief engineer and general manager, Mr. W. G. T. Goodman, M.Inst.C.E., M.I.E.E.; secretary, Mr. Chas. R. Moyes; accountant, Mr. C. A. Smith.

In the general conduct of the undertaking it compares favourably with the most advanced of British tramways. A system of "concession" tickets has been introduced by which passengers may obtain tramway tickets in dozens at reduced rates. School children's tickets, both season and sectional, are issued at low rates, and from the figures given in the latest returns it appears that the privilege is appreciated by the young people of Adelaide.

The rolling stock of the Trust comprises the following items: 70 combination-type four-wheel cars; 30 open-type four-wheel cars; 20 bogie combination cars; 50 closed bogie cars; three water sprinklers. A 20-H.P. petrol-driven breakdown lorry has been placed in the service and equipped with all the necessary emergency and ambulance gear.

The financial position of the Adelaide Municipal Tramways Trust is stable, and shows a high rate of return on the capital invested in the undertaking. According to the financial report for the half year ended January 31, 1914, the gross revenue was £163,719, and the total expenses £101,477, giving a net revenue of £62,242. The capital cost of the system, excepting purchase money and stores, was £1,350,496, and the surplus revenue being £62,629, the return on the capital amounts to 9·26 per cent. The latest returns show even better results.

It will be understood from the foregoing that the Adelaide Municipal Tramways Trust has many more points of interest than those we have touched upon, but our space is limited, and forbids record of further particulars. In the accompanying table a clear view of the financial results of the working of the whole undertaking from July, 1907, to July 31, 1914, is given.

The responsible officers on the staff of the undertaking are the following:

Chief engineer and general manager	W. G. T. Goodman.
Chief assistant engineer	E. S. Moulden, A.M.I.E.E., A.M.Am.I.E.E., A.M.I.Mech.E.
Secretary	C. R. Moyes, A.C.U.A.
Accountant	C. A. Smith, A.C.U.A.
Traffic superintendent	A. E. Ford.
Rolling stock superintendent ..	C. H. Wickham, A.M.I.E.E., A.M.Am.I.E.E.
Overhead superintendent	C. F. Hursthouse.
Permanent way superintendent ..	W. Davies.
Chief draughtsman	J. A. McDonald, A.M.I.Mech.E., A.M.Am.I.E.E.
Resident engineer for track construction	J. Bowman, Assoc.M.Inst.C.E.
Comptroller of stores	G. S. Lindsay.

The area served by the tramways of the Trust is approximately 28 square miles. Within this wide area the effects of the service are shown in the increase of building operations. During five years the suburban districts of the city increased largely in population, over 11,000 buildings having been erected.

Rosebery Prizes at London School of Economics.—A foundation has been endowed by Lord Rosebery by which one prize of £25 and one prize of £10 will be awarded annually for the best monographs on a question dealing with the history, theory, or organisation of inland transport. The monographs may represent either a piece of original research for a subject which has previously been submitted for approval, or be written on a set subject. Such set subject shall be announced in the year preceding that in which the monographs must be presented. For 1916 the subject is "Workmen's Trains." Candidates must be present or past students of the London School of Economics and Political Science. Two or more students may combine and present a joint monograph. Monographs must reach the director of the school not later than September 30, 1916. The option will lie with the school of publishing the monograph to which is awarded the first prize.

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A NEW TYPE OF ELECTRIC CAR FOR THE NEW YORK MUNICIPAL RAILWAY CORPORATION.

A new type of all-steel car for some of the extensions of the New York system of underground and elevated electric railways presents many features of interest. It may be recalled that a few years ago it was determined that the extensions of these railways should be built by the city, and that their working should be leased to companies for a long term of years, the net profits to be divided in certain proportions between the city and the companies. The companies were to provide the equipment. The cars hereafter described, which are now going into service, were supplied to the New York Municipal Railway Corporation, a company organised by the Brooklyn Rapid Transit Company to equip the lines allotted to it under the dual plan. The design of the cars is a departure from other American types, and presents features of special interest.

The rapidly increasing traffic of the present New York Subway has emphasised the necessity for a car that will afford the greatest possible facility in the handling of passengers and provide the maximum accommodation and comfort. The officers of the railway company realised that in order to obtain the required improvements it would be necessary to make a radical change in the design of the car from that heretofore used in similar service, and that these improvements could only be fully realised by entirely ignoring their present rolling stock as far as interchangeability in operation with their new equipment was concerned. Such a procedure was justified by the fact that the new system, when completed, will include a total length of 293 miles measured as single track, old, reconstructed, and new permanent way, or nearly double the existing 106 miles of elevated track and its surface extensions.

In connection with the preliminary studies of the type of car best suited to meet the operating requirements of the new system, data were collected from several roads operating under similar conditions, and a careful analysis made of the various designs in use. From these studies it became evident that in order to obtain the required improvement in accommodation for passengers without sacrificing facilities for promptly despatching the crowds during the "rush-hour" periods, a more commodious arrangement than that afforded by existing equipment would be necessary, and that this could only be obtained by increasing the size of the car. This led to the adoption of a car 18 ft. longer and about 15 in. wider than the cars in use on the company's existing elevated lines. The general dimensions of the new cars are shown in Fig. 2.

The following table gives an interesting comparison of the general dimensions, capacity, and weights of the New York Municipal Railway Corporation's new steel car, the latest steel car of the Interborough Rapid Transit Company, the Hudson and Manhattan Railroad Company, and the Long Island Railroad Company, operating in similar service :—

COMPARISON OF SIZE, WEIGHT, AND CAPACITY OF VARIOUS STEEL SUBWAY CARS.

	I.R.T. Co., New York Subway.	H. & M.R.R. Co., Hudson River Tubes.	L.I.R.R. Co., Flatbush Subway.	N.Y.M. Ry. Corp.
Length over buffers ...	51 ft. 0½ in.	48 ft. 0 in.	51 ft. 2 in.	67 ft. 0 in.
Width over side sheets ...	8 ft. 7 in.	8 ft. 7⅜ in.	8 ft. 7 in.	9 ft. 9⅞ in.
Passenger seats	44-46	44	52	78-90
Weight, light ...	77,870 lb.	74,100 lb.	79,564 lb.	85,000 lb.
Weight, light per passenger seat	1693-1769 lb.	1684 lb.	1530 lb.	945-1090 lb.

Comparing the capacity of the New York Municipal Railway Corporation's car with the latest steel cars of the New York Subway, it will be noted that there is a remarkable increase of from 77 per cent. to 95 per cent. in the seating capacity in favour of the New York Municipal car, while the increase in length and weight of the latter car over that of the New York Subway is only 31 per cent. and 9 per cent. respectively. A train of eight cars of the New York Municipal Railway is approximately of the same length as a train of ten cars of the Interborough Rapid Transit Company. In the eight-car New York Municipal Railway train there will be 4,711 sq. ft. of floor space available for passengers, as against 3,702 sq. ft. for passengers in the 10-car train now operated in the New York Subway. The present Subway express train carries approximately 1,200 people in the morning and evening rush hours. On this basis each car of the eight-car train on the New York Municipal Railway will carry 150 people, of whom 78 will be sitting, as against 120, of whom 44 are sitting,

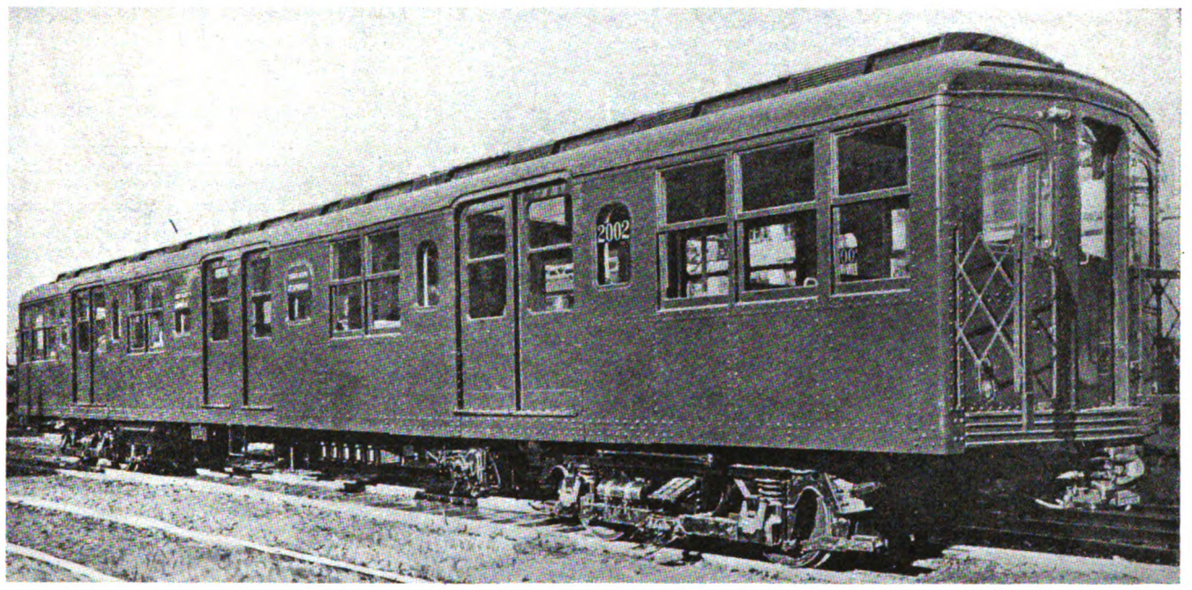

Fig. 1.—Electric Car for New York Municipal Railway.

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in the present New York Subway car. The 72 standing passengers per car in the New York Municipal Railway train will have 306 sq. ft. of standing space per car, or 4¼ sq. ft. per person, whereas the 76 standing passengers per car in the present New York Subway train will have 187 sq. ft. of standing space per car, or 2½ sq. ft. per person. Thus, on the eight-car train of the New York Municipal Railway, with a rush load of 1,200 people, 624 will be seated, as against 440 people out of 1,200 in the present New York Subway 10-car express train in rush hours.

Special attention having been given to the seating arrangement and spacing as well as the number of doors, in order to facilitate ingress and egress, it seems reasonable to assume that the increase in capacity per train of equal length, or, in other words, per foot length of train, should be manifested by proportionate ultimate increase in capacity of the lines. Likewise, it naturally follows that inasmuch as an increase in capacity is obtained with a decrease in number of units operated, the maintenance cost of equipment for a given service will be lower with the larger car. Again, as the latter car requires only the same number of equipment parts, such as motors, trucks, control, air-brake parts, etc., the original cost of equipment for a given service will be less. Furthermore, with the large car better accommodation can be obtained for the passengers by providing better seating arrangement and more aisle space and greater room at exits, thereby reducing the objectionable "crowding" met with in heavy traffic centres of large cities. Therefore from an economic, as well as all operating standpoints, the comparison between the smaller car, at present almost universally used for subway and elevated service in large cities, and a car of greater size and capacity, such as adopted by the New York Municipal Corporation, is unquestionably in favour of the latter.

The adoption of the large car, nevertheless, had certain drawbacks. Undoubtedly one of the greatest obstacles in the way of operating a large car in subway and elevated service is the short radii curves encountered; in fact, this may be the sole factor in determining the length of car that can be operated. In the construction of the new lines over which the New York Municipal Corporation cars will operate, it was possible to limit the horizontal curvature to a minimum of 175 ft. radius, and the maximum change in grade will not exceed 6·80 per cent. The new cars are designed to operate around 125 ft. radius curves.

The following description of the new cars is abstracted from articles contributed by Mr. W. E. Johnson, engineer for car construction of the New York Municipal Railway Corporation, to *Electric Traction*, of Chicago, and to that journal and the *Electric Railway Journal*, of New York, we are indebted for the illustrations which show the construction of the vehicle.

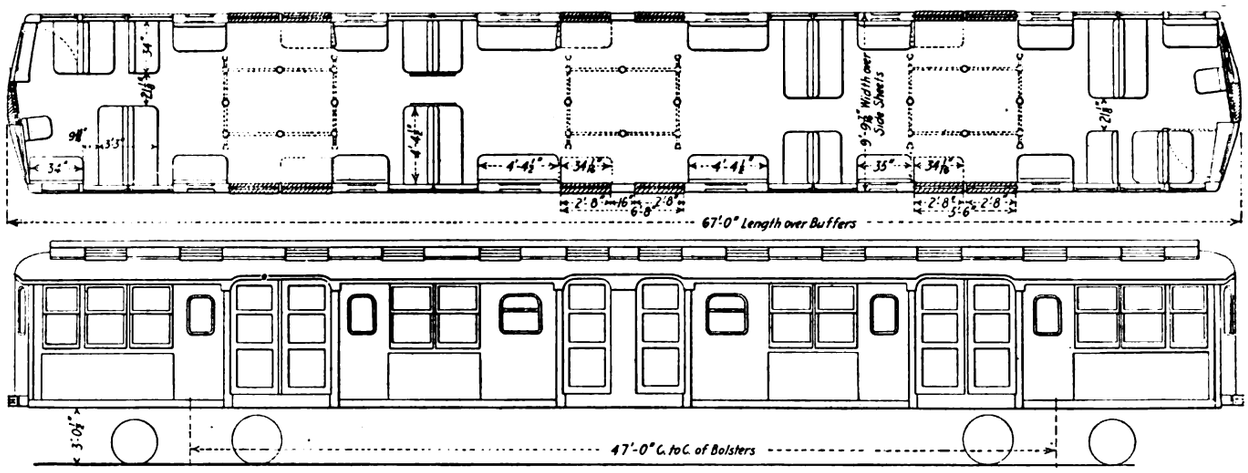
In Fig. 1 is shown an exterior view of the car adopted, and the interior arrangement is shown in Fig. 2. This is the first car delivered out of a lot of 600 on order or under option.

Seating Arrangement.

A great deal of study was given to the seating arrangement, with a view to providing the maximum accommodation consistent with accessibility, freedom of movement, and facility of entering and leaving the car, as well as with the comfort of the passengers. The final result of these studies is shown in the plan view Fig. 2. The use of some cross-seats was made possible without interfering with the free movement of passengers by the unique arrangement of placing the seats so as to virtually divide the car into three separate compartments, with a pair of doors for each compartment on each side of the car.

Folding seats are provided to drop down opposite one door in each pair. These will be used during the hours of light traffic, and will add a total of twelve to the normal seating capacity of 78, making the number of seats available during the non-rush hours a total of 90. By placing folding seats at one door only out of each pair the number of points of exit will remain the same at all times, thus avoiding confusion due to entirely closing certain exits where folding seats are used. In the design of the seat itself the New York Municipal Railway secured the co-operation of the American Posture League, a national organisation of orthopedic experts. The company submitted tentative designs for a seat to a committee of experts of the League, and they were checked up according to measurements of many hundred individuals of varying physical types, and a report submitted, on the basis of which a series of seat models were made in the endeavour to attain a final design which should be consistent with the anatomical principles on which the League's recommendations were based and the practical operating necessities which were controlling factors on the railroad.

Ultimately such a design was found, and is embodied in the seat adopted for the New York Municipal Railway car. Fig. 6 shows the side and transverse seats occupied, and illustrates particularly the adoption of the seat design to the curve of the back. It also indicates the support given to the shoulders. There is the further advantage that in the case of the transverse



Figs. 2 and 3.—Plan and Elevation of New York Car.

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seats passengers sitting back to back are held so that neither their heads nor their hats will bump when the train is in operation. The new seat holds the passenger firmly and comfortably in a correct upright posture, and its very correctness of design discourages attempts to get into an incorrect posture, because such an attitude cannot be held without constant bracing,

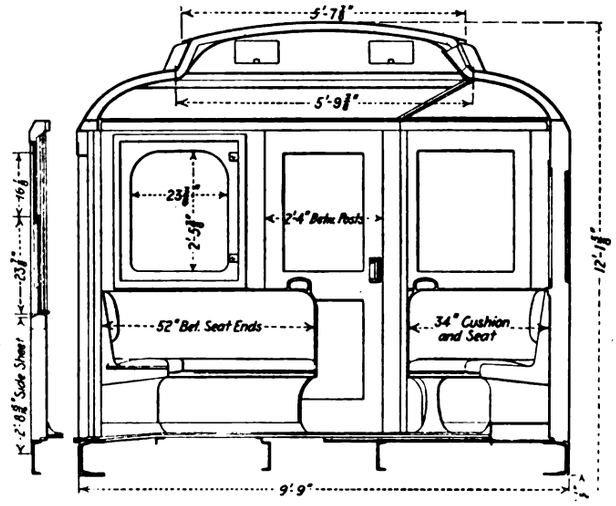

Fig. 4.—End Elevation of Car Body.

even when the car is standing still, and must become almost impossible when the car is in motion.

Sanitary Arrangements.

Special measures have been taken in the design of interior arrangement and finish to provide a sanitary construction throughout. The floor, which is of cement or monolithic composition, is arranged with a sanitary cove 2½ in. high at all sides and intersections with seat pedestals. This cove is neatly rounded at all corners to eliminate places where dirt and dust can lodge, and to permit of readily flushing the floor with water when cleaning. All stanchions, railings, and handholds are white porcelain enamelled, and the entire interior finish is of hard drying enamel that can be washed with soap and water. A white finish

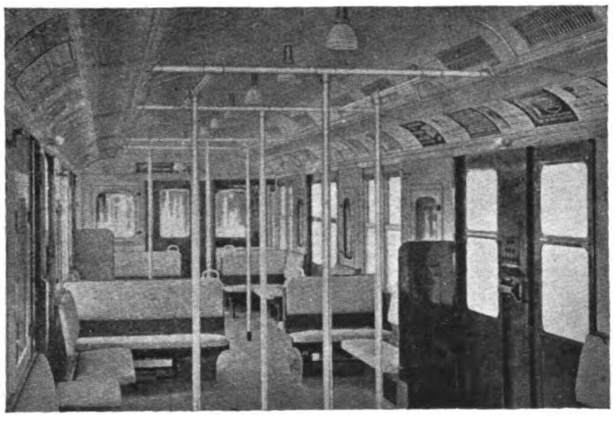

Fig. 5.—Interior View Showing Seating.

is used for the entire ceiling, as well as for the side walls down to the window sill. An olive green is used below the window sill and for the seat frames and doors. Ledges and projections, where dust can collect, have been avoided wherever possible, with the result that the interior of the car presents a neat and sanitary appearance. Agasote is used for all the interior trimming.

Illumination.

In their search for the lighting system best suited for their new car the engineers of the New York Municipal Railway Corporation kept constantly in mind the efficiency of the system from the standpoint of providing adequate and evenly distributed light throughout the car, and the elimination as far as possible of the causes of eye-strain and fatigue. It was necessary to make a very extensive and thorough investigation of the problem. For this purpose, as well as for the purpose of studying various other features of the design, a full-size model of the car was constructed.

The lighting arrangement finally adopted provides for fifteen 56-watt Mazda lamps, 13 placed in a single row in the centre of the upper deck and one on each bulkhead deck, all provided with Holophane Sudan reflectors, giving a total of 840 watts.

In addition to the regular lighting system an emergency system is installed, consisting of six 10-watt, 34-volt lamps, one placed between each pair of side doors. These lights are operated from a storage battery, and will only burn when power is off the rail and the main lighting circuit cannot be obtained, being thrown on automatically whenever the car does not make contact with the third rail or when the power is off the line.

Car Couplers.

The car couplers and their various parts represent the latest development, and include several entirely new and original features. Heretofore all the air, electric, safety-gate, chain, and other connections have had to be made by hand, requiring a man to go between the two ends of the cars to be coupled, a more or less hazardous employment. All these couplings are now worked automatically in the New York Municipal Railway Corporation's car, and, in addition, the tail lights are arranged so as to automatically cut out between coupled cars, and will always show the correct colour on the front and rear of the train without any attention from the operator. The tail lights, as well as the marker lights in the

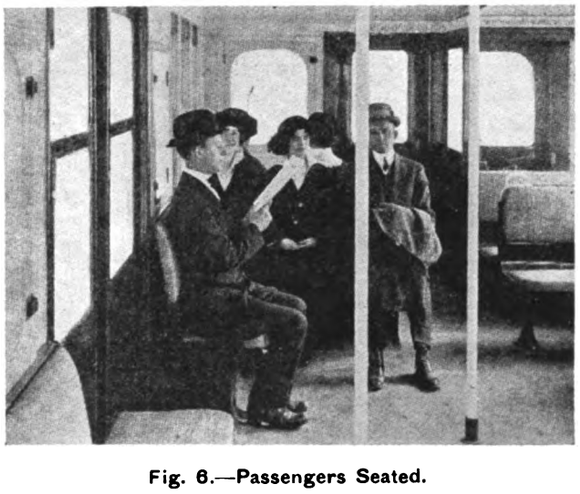

Fig. 6.—Passengers Seated.

hood of the car, are carried on the same battery as the emergency lights.

In this connection it will be interesting to note that on the existing elevated cars of the Brooklyn Rapid Transit system, which in this respect are similar to elevated and subway cars used in other cities, there are no less than 16 couplings to be made by hand between the cars each time they are coupled together

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for service, these being divided as follows:—Car coupler, 1; air brake hose connections, 2; electric control connections, 2; heat and light connections, 1; safety gates, 2; guard chains, 6; safety chains, 2; total, 16.

The entire draft rigging, including car coupler, electric coupler, radial drawbar, draft gear, and draft gear attachments are being furnished by the Westinghouse Traction Brake Company. The draft gears are arranged for a movement somewhat in excess of the travel required to bring the car buffers together, and have a capacity, when solid, of approximately 185,000 lb. All connections are designed so that the sum of the maximum unit stresses to which the member is subject shall not exceed 20,000 lb. per sq. in. for buffing, nor 12,000 lb. per sq. in. for pulling, a force applied horizontally at the centre line of coupler heads of 185,000 lb. for buffing and 100,000 for pulling being assumed.

Brakes.

In a car of this type, where the light weight is low with an unusually high capacity, the full passenger load, in this case representing an increase in weight equal to approximately 45 per cent. of the weight of a light car, the braking problem becomes more difficult. The railway engineers placed the requirements of a device to meet the conditions before the manufacturers of air brake apparatus, with the result that tentative designs were submitted by the manufacturers, which were carefully considered by the railway engineers, and as the design seemed to be entirely practicable, it was, with some modifications, finally adopted. The conditions specified were extremely exacting in their requirements, and had never before been accomplished to the full extent prescribed. A brief description of this device will be interesting, and an abstract from the specifications covering this feature is given below:—

"The device shall be: (1) Automatic in action; (2) individual in action on each and every car of a train; (3) shall not change adjustment or be actuated while the train is in motion; (4) the percentage of braking power obtained during a service application shall increase uniformly on all cars of the train in accordance with the progress of the reduction of brake pipe pressure; (5) accidental derangement of parts shall not result in failure to obtain at least light load braking power; (6) must be provided with such means for cutting out the device that light load braking power only will result."

The air brakes adopted for this car are of the Westinghouse automatic schedule "AMUE," and represent the very latest development in air brake equipment for rapid transit service, including several new features calculated to obtain the maximum efficiency. The application and release of the brake are controlled electrically as well as pneumatically, and both methods provide for a graduated release of brake cylinder pressure, making possible a smooth rate of retardation.

The trucks are equipped with the clasp brake system, i.e., with two brake shoes per wheel, one on each side, and the foundation and truck brake rigging is designed to deliver a braking pressure equal to 90 per cent. of the weight on the trailer wheels, and 110 per cent. of the weight on the driving wheels, these ratios being calculated for the loaded car, under which condition the full brake cylinder pressure of 50 lb. for service application is effected through the empty and load brake attachment referred to above. The reduction in braking power to compensate for decrease in passenger load is obtained through the empty and load attachment by introducing volume in series with the brake cylinder, so that the equalisation of the auxiliary reservoir pressure in the brake cylinder will be correspondingly reduced, this empty and load brake attachment being actuated by the deflection of the truck elliptic springs only when the car is at a standstill and while the doors are open; thus the variable deflection of these springs, when the car is operating, would have no effect upon the device. The specifications prescribe that the average rate of retardation for service stop from an initial speed of 50 miles per hour shall be guaranteed to be not less than two miles per hour per second, and, in an emergency stop, not less than three miles per hour per second under the condition as prescribed by the specifications, and a provision that the product of the efficiency of the brake rigging and the average coefficient of friction of the brake shoes throughout the stop, expressed in percentage, shall be not less than 9·5 per cent.

Motive Power.

The cars will be propelled by two General Electric type 248-A interpole, field control motors, having a normal rating of 140 H.P. each at 600 volts, according to the standard of the American Institute of Electrical Engineers, controlled with Westinghouse "bridge" type "ABE" electro-pneumatic multiple unit control.

In order to obtain a high efficiency the motors are designed with a low gear ratio (2·77 : 1) and a comparatively slow armature speed when operating on the full field, for local operation; the required increased speed for express service being obtained by operation on the "tapped" or normal field. The motors are guaranteed to give a schedule speed from 59th Street, Manhattan, to Coney Island, *via* East River Tunnel, of 15 miles per hour for local service, and for a typical express run with the average distance between station stops of 7,318 ft., a schedule speed of 25 miles per hour is guaranteed. Actual service test of motors indicates that these schedules will readily be met. The control and motor equipment includes several new and unique features in arrangement and design, of substantial improvement over past installations, affecting both the original installation and future upkeep.

Among these may be noted the method of grouping the various parts of control apparatus into one unit. The six control switches, one reverser, one commutating switch, and three relays are all mounted together in a main frame with suitable brackets for attaching direct to the car framing, without the use of any supplementary supports; each unit being so connected that it may be readily removed without removing or unclamping any other unit, as well as being arranged so as to be easily accessible for inspection without being taken apart. This arrangement materially simplifies the car wiring installation, inasmuch as all of the wiring and conduit required to connect these various units when installed separately are dispensed with.

Another important improvement is the introduction of a simple and effective device for automatically regulating the current input so as to obtain a uniform rate of acceleration regardless of passenger load. This device is similar in its function to the "empty and load" brake attachment described above, which maintains a uniform rate of retardation.

Auxiliary circuits for operating the electro-pneumatic brakes, tail lights, and car signals are included in the control cable, and contacts and terminals are provided in the master controller and junction boxes for them. All these auxiliary circuits, including those required for operating the control, are carried through the coupler heads. In all, 18 connections are provided for.

The current for operating all the above circuits, as well as for the marker and emergency lights and

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electro-pneumatic operation of doors, is obtained from an Edison type B1-H 34 volt storage battery floating on the line in circuit with the compressor motor and car lights.

Doors.

There are six doors in pairs on each side of the car for ingress and egress, and one door in each end for passing from car to car. The side doors are spaced so as to minimise the walking distance in entering and leaving, thus facilitating movement of passengers and reducing length of train stops at stations. Considering a fully loaded car, the average distance that each passenger must walk to reach doors is only 6 ft. 10 in., as compared with approximately 12 ft. for existing elevated cars with end doors only, and 7 ft. 6 in. for New York Subway cars with two end and one centre doors.

The doors for each car are controlled by a trainman standing in the middle between the two centre doors, thus affording him full view of all doors under his control. Each door is operated by a single double-acting air cylinder, directly connected to a bracket on the door, the air being controlled through one electro-pneumatic valve for each pair of side doors and one valve for each end door, operated by push buttons located on a pillar between centre doors. The push buttons are arranged so that by the pressing of one button all doors available for use on one side of the car will open, while a separate button is provided for the closing of each pair of side doors. When the folding seat at any door is down the air is automatically cut off from the cylinder of that door, and a mechanical latch engages it, so that it cannot be opened. Separate buttons are provided both for opening and closing each door in the end of the car.

A signal circuit connected through interlocking switches placed in plain view behind the swing sash in the door pockets is provided and arranged to open and close respectively with the opening and closing of the doors. The closing of the last door completes this circuit, and lights a small lamp in the top of the master controller in the motorman's cab, which is a signal for the motorman to start the train.

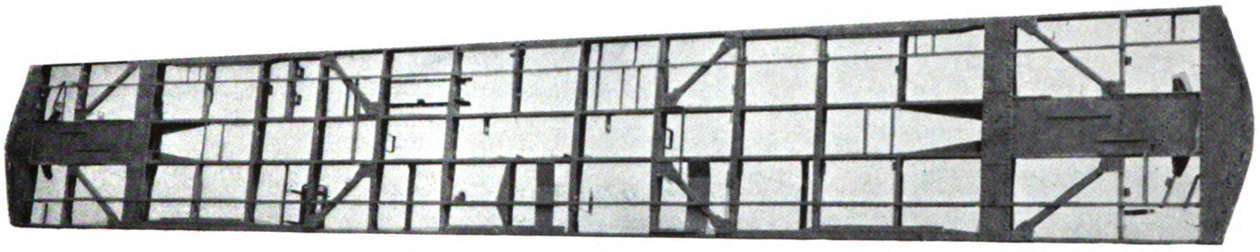
Underframes.

The large number of cars involved—the initial equipment for the completed lines requiring a total of 600—made the use of pressed steel economical, and advantage was taken of this to the fullest extent in order to reduce weight. The full side truss type of construction was adopted as the type that would best meet the requirements as to strength and light weight; the underframe members therefore, only being required to transmit the load to the side frame and care for buffing strains, could be of reasonably light sections. Floor loads and equipment units are carried on cross members of 3-16 in. diaphragm pressings, 7 in. deep, with 2¼ in. flanges extending between the sills riveted thereto, and provided with copper plates on the top and bottom to give the required strength. These cross members also serve to carry the centre sills in proper alignment, and to prevent these from buckling under buffing strains. The centre sills are of 7 in. 14·75 lb. channels. Between bolster and end sill these channels are supplemented with a 30 by 3-16 in. cover plate, and further reinforced with a special pressing, extending through the bolster back to the first cross member, serving as a draft sill. Diagonal braces are provided. This arrangement, together with the extraordinarily wide buffer, serves to distribute a proportionate share of the buffing stresses to the lower members of the side frame.

Body Framing.

Except for headers and hood framing, which are built up of plates and angles, and headlining and wainscoting below the window sill of "Agasote," the entire superstructure is of pressed or drawn steel. The multiplicity of side sliding doors makes it advantageous to utilise the exterior sheathing of the door pockets to transmit stresses to the body plate, which forms the top member of the side truss. When stiffeners were required for the main side pressings, these were located on the inside of the plates, thus leaving the exterior of the sides smooth with fewer laps and joints to cause trouble due to corrosion.

Special provisions were made to prevent "telescoping" by installing heavy cast steel casings at the lower end of the end door posts, and by the use of 3-16 in. pan-shaped pressed steel gussets behind the corner body posts, extending from window sill to side sill and between the corner and adjacent side post.



Underframe of New York Municipal Railway Car.

The roof construction is a compromise between the "single arch" and "clerestory deck," with the ceiling closely resembling the full "Empire" type. Carlines are of 3-32 in. pressed steel "U" section, with 1 in. flanges turned outward at the upper side. The deck plate, as well as both the upper and lower deck roof sheets, are of 1-16 in. "ingot iron," used on account of its rust-resisting qualities. All joints in the roof are electrically welded. A commendable feature of the roof construction is in its extreme simplicity, the only other member in the main body of the roof, in addition to those named in the foregoing, being the deck sill, which is of 5-32 in. steel pressed in the form of an arc of a circle and riveted to the lower side of the carlines.

Tramways and Light Railways Association.—The March number of the journal of this association contains a very useful article on "Railless Traction and Motor Omnibus Legislation." Mr. Harry England, vice-chairman of the Tramways and Light Railways Association, read a paper on "Railless Traction Legislation" before the congress held in June, 1913, in which he gave an analysis and digest of Private Acts dealing with railless traction passed by Parliament up to the year 1913. Last year the Municipal Tramways Association prepared a digest and analysis of Private Acts authorising the construction and working of railless traction and motor omnibus enterprises during the Parliamentary sessions 1913 and 1914. From these two papers the editor of the journal has compiled a full and detailed account of all the Acts referring to railless traction and dealing with motor, omnibuses passed up to the end of last year.

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LONDON, MAY 13, 1915.

Municipal Expenditure.

An example of the stringency with which H.M. Treasury are acting in preventing local authorities from raising new loans is given by the correspondence which was presented at a meeting of London County Council a few days ago. It will be remembered that some time since the Local Government Board issued a circular letter to all local authorities informing them that during the present war the sanction of the Treasury would be necessary to all proposals for raising additional capital for new works, and that no such sanction would be given except in respect of works urgently needed from the public health point of view or for expediting naval or military operations. The desire was also expressed in regard to works now in progress that their completion should, wherever possible, be postponed. The Comptroller of the London County Council, on behalf of the Finance Committee, wrote to the Treasury asking for more precise information as to different classes of work, and several letters received in reply are now published, along with additional circulars from the Local Government Board. As a result of these it is clear that some improvement works which the Council have in hand or in contemplation will have to be postponed during the period of the war. In particular, the Treasury object to proposed borrowing powers of £271,900 contained in the Council's Tramways Bill of this session for new lines, etc. In regard to some works, however, which are well advanced or nearing completion loans will be sanctioned. A notable feature is the authorising of loans to certain metropolitan borough councils for extensions of their electricity undertakings on the basis that the proposed works are for supplying Government or other workshops engaged in the production of munitions of war. A prominent example is Woolwich, whose power station already, we believe, supplies some electric energy to Woolwich Arsenal. From other parts of the country also comes news of tramway and other works being suspended. The object of the Government, of course, is plain, namely, to conserve capital as well as the supply of workmen for national needs during the present period of stress. While local inconvenience, and sometimes something more, may be caused, the public will submit without grumbling. The circumstances are very different from those in the early days of the war. Then it was feared that there would be unemployment and distress, and local authorities were urged to put works in hand. Now, instead of unemployment, there is a scarcity of labour, and capital is to be held up for national contingencies instead of being expended locally.

Relation between Fares and Efficiency.

The efforts which American street railway companies are making to raise the standard of fares strike a sympathetic chord in the heart of every British tramway manager. American undertakings, like our own, have been burdened with rising costs of service, increased taxation, and more exacting demands on the part of the travelling public. They find a peculiar difficulty in meeting this change of conditions, inasmuch as the uniform five-cent. fare is a barrier to any of those partial adjustments which are possible with a system of graded fares. No British tramway manager would experience any trouble in meeting an increase in working cost by shortening stages or amending

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fares on certain routes, if he were free to do so. It is notorious, however, that fares are determined more by public opinion than by ordinary commercial considerations. Tramway companies are generally under rigid obligations regarding fares and conditions of service to the local authorities whose districts they serve. Municipal tramway undertakings are under the control of popularly-elected committees, whose tendency is rather to make new concessions than to restrict those already granted. These factors explain why, during a period in which almost every trade has raised the price of its services, tramway fares continue at the pre-war level. The margin of profit in normal circumstances was narrow enough; increased cost of coal and every class of material, higher labour charges, increased difficulty in finding suitable men as drivers and conductors, and the disturbance of traffic, have combined to make it narrower than ever. Tramway undertakings therefore have a good case for following the upward trend of prices, but owing to the complex obstacles in the way of altering fares, they have preferred to "carry on" upon the old basis. Perhaps this determination will prove to be best in the long run, as no temporary measure of relief would meet the necessities of the case. What the tramway undertakings have to endeavour to compass is the education of the public and its leaders in the principle that narrow margins tend to inefficient service This is not a popular principle, nor one that tends to enthusiasm among reformers; but it is a sound one. The American companies, it appears, have more hope than British undertakings of securing a practical recognition of the principle. Their destinies are governed by Public Commissions, which seem to be amenable to business-like arguments. For instance, at a recent banquet of the New England Street Railway Club, Mr. McLeod, Chairman of the Massachusetts Public Service Commission, stated his conviction that, in the main, the rates now charged by trolley roads under the old Bay State were insufficient to enable the companies to give the kind of service the public has a right to demand, to conserve the property adequately, and to provide for depreciation. He went so far as to recognise that a return upon the capital invested was a consideration not to be overlooked; and he urged that the interests of the public and of the utility companies were identical in the long run, and that it would be far better for the electric railways to raise their rates and give "real service" than sink into a moribund financial condition. That courageous utterance should, as an American writer predicts, "point the way to better days for deserving electric railways;" and we regret that the destinies of British tramway undertakings are not in the hands of men who are able to show equal insight and equal independence.

Motor Omnibuses in America.

The perturbation among street railway companies in the United States, to which we have previously referred, over the advent of what is called the jitney 'bus continues, but apparently the alarm is decreasing. "Jitney," it should be explained, is American slang for five cents, the equivalent of our twopence halfpenny, and this is the fare which is being charged by the omnibuses for all distances—greater in some cases than the ride given by the tramways for the same fare. The competition from these new vehicles, strangely enough, began in the towns on the Pacific slope and seaboard, where presumably the road surfaces are not equal to those in the eastern States, and it has gradually spread eastward. A committee of the American Electric Railway Association, which investigated the matter, is of opinion that the omnibus cannot pay. This will probably prove true in most cases, because the municipalities are putting restrictions and charges on the 'bus which will have the effect of controlling its operations and of compelling it to contribute to the local public exchequer in the same way as the street railways have to do. Thus any 'bus profits will tend to disappear. In some of the western towns of Canada, where the street railways are more or less under public ownership, the municipalities are taking even more drastic steps, which amount practically to a prohibition of the running of the vehicles, especially in competition with the tramways. While these things are so, it can hardly be doubted that before long properly organised companies with sufficient capital will put

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omnibuses of the latest type on the streets in many cities. The experience of London will be repeated, though probably not to the same extent because American cities are much better supplied with tramways than London. If the worst for the street railway companies comes, they will have to acquire or enter into working agreements with the omnibus companies. The day of such a necessity, however, is not yet.

THE WAR AND TRAMWAY INVESTMENTS.

So far as tramway administration, whether municipal or company, in this country is concerned, the war has had comparatively little influence. Indeed, the managers of some undertakings, to say nothing of members of tramway committees or boards of directors, as the case may be, can scarcely have realised the extent to which the war has demoralised the business of various undertakings of this class operating abroad or in the colonies. In the course of the present article we will take three leading undertakings of this class, and endeavour to show briefly how they have been affected by the international upheaval. The undertakings we refer to are the British Colombia Electric Railway, the Brazilian Traction, Light and Power Company, and the Mexico Tramways Company. In the following table are set out the highest prices reached by the securities of these three undertakings during 1913 and 1914, and the present quotations :—

	Highest 1913.	Highest 1914.	Present Price.
Brazilian Traction, Light and Power Ordinary Shares ($100)	104	94½	57xd.
Do. 6% Cum. Pref. ($100)	101	102½	96
British Colombia Electric Deferred Ordinary	144½	123	49
Do. Pref. Ordinary Stock	125	109¾	56
Do. 5% Cum. Perpetual Pref. Stock ...	109¾	106⅛	79½
Do. 4½% 1st Mortgage Debentures ...	103	100¾	94½
Do. 4½% Vancouver Power Debentures	102	97½	94½
Do. 4½% Perpetual Consd. Debenture Stk	100	97¼	81
Mexico Tramways Common Stock ($100) ...	115	79	40
Do. General Consolidated 1st Mortgage 50-Year 5% Gold Bonds ...	99½	88	57½
Do. 6% 50-Year Mortgage Bonds ...	102½	89	35

It will be seen from the above figures that there has been a very heavy depreciation, particularly in the junior securities of each company, the most serious fall being shown in the securities of the Mexico Tramways Company, which has extended to both issues of Bonds as well as to the common shares. In almost every case, moreover, prices are not by any means at the lowest reached since the outbreak of war. In all three cases the war must be regarded as the ultimate cause of the depreciation, but in the case of the Brazilian Traction and the Mexico Tramway securities the conditions of the countries in which they are located, and the heavy depreciation in the exchange in both Brazil and Mexico, have been serious contributory causes. Some description of each of the three undertakings may be interesting at the present stage.

The Brazilian Traction, Light and Power Company has a share capital issued of over $114,000,000. It leases the Rio de Janeiro Tramway, the San Paulo Tramway, and the San Paulo Electric Companies, and, indeed, was formed by an exchange of shares of those three companies for shares in the Brazilian Traction Company in varying proportions. For the year 1913 a dividend of 6 per cent. was paid on the common shares (namely, 1½ per cent. quarterly), and this rate of dividend has been maintained up to the present date, 1½ per cent. being payable 1st June next. Indeed, the gross receipts, according to the latest returns, seem to have been fairly well maintained. The aggregate receipts for January and February, 1915, show a gross decrease of only 185,000 milreis, and a net decrease of only 43,000 milreis. These figures, of course, do not take into account the depreciation in the sterling value of the Brazilian currency receipts, which was really the most serious problem in front of this company last year. Fortunately the depreciation in the exchange is not nearly so serious as it was, and this has been reflected in some recovery in the price of Brazilian Traction ordinary shares, which were at one time somewhere in the neighbourhood of 40, as against the present price of 57xd. The report for the year 1914 should be presented in Toronto next month. The company itself is incorporated under the laws of the Dominion of Canada, and is controlled for the most part by Canadian directors. If the company has no more serious decrease in gross receipts to face than recently, and if the exchange is not more seriously depreciated than at present and, also, if it can dispense with raising any further capital, there is no reason why the recovery in its common stock should not continue. It will be observed that the preference shares are fairly well maintained, but the issue is a small one, namely, only one-tenth of the ordinary capital,

The British Colombia Electric Railway Company is one of the best known Canadian enterprises, and has hitherto been one of the most successful. Its operations extend over 335 miles of track in the neighbourhood of the cities of Vancouver, New Westminster, and Victoria, B.C., and the dividend on the deferred stock was maintained at 8 per cent. for several years until 1913-14. Its total capital is about 7½ millions sterling. In the report submitted last December the directors made the following statement :—"Stockholders must be prepared for a drastic reduction in future dividends," and added, "but the directors believe that the future development of the Province will in the end result in more stable conditions." The war probably hit the Western District of Canada more severely than any other part of the Empire, and the report of this company already referred to quoted the fact that the population of Vancouver and neighbouring districts decreased by about 20,000 inhabitants in consequence. The latest official return of the British Colombia Electric Railway (that for February, 1915) showed the net earnings had decreased by more than 50 per cent., and that from July 1, 1914, to date there had been a decrease of $470,000, say nearly £100,000, whilst the whole dividend of 8 per cent. upon the deferred stock is only a matter of about £115,000. The position of this company may be handicapped for some few years, particularly as capital commitments have been increased, but it has considerable reserves. So far as some of the senior securities are concerned the depreciation would appear to have gone far enough.

The position of the bondholders and stockholders of the Mexico Tramways, in common with that of most people who have financial interests in Mexico, is rather pathetic. The series of revolutions had brought about complete demoralisation even before the European War began, and the latter event has made it less probable that the large amount of capital necessary for the resuscitation of the Republic of Mexico will be readily forthcoming, and the natural recuperation of the country may thus be delayed, even if political disturbances are removed. The share capital issued is

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$20,000,000, and the two issues of bonds represent over $16,400,000 further. The company is incorporated under the laws of the Dominion of Canada. For the years 1911, 1912, and until November, 1913, 7 per cent. was paid in quarterly instalments on the common stock of the Mexico Tramways, which operates in the city of Mexico and the surrounding district. Unfortunately, in December last the company had to announce default in the payment of the half-yearly coupon due January 1, 1915, on its 6 per cent. bonds. This was followed on February 23 by the further announcement of default in interest due March 1, 1915, on the 5 per cent. first mortgage bonds. Owing to the chaotic condition of the country the exact details of earnings, &c., have not latterly been available, and the latest return is one issued in January for the month of November, 1914. This showed a considerable increase, in Mexican currency receipts, of $379,000 from January 1 to November 30, 1914, inclusive, but on the other hand operating expenses had also increased by $576,000 Mexican currency, leaving a net decrease of rather under $200,000 for the eleven months. This of itself is not particularly serious, but what the Mexican dollar is worth in sterling is really the crux of the company's serious position, and fully explains why it has not been able to maintain the interest on its bonds. It will be observed that even the bonds of this company stand at seriously depreciated prices as compared with the highest prices for 1913 and 1914, but ultimately there would seem to be some scope for recovery at any rate in these issues, if not also in the common stock.

TIME SCHEDULE INDICATOR.

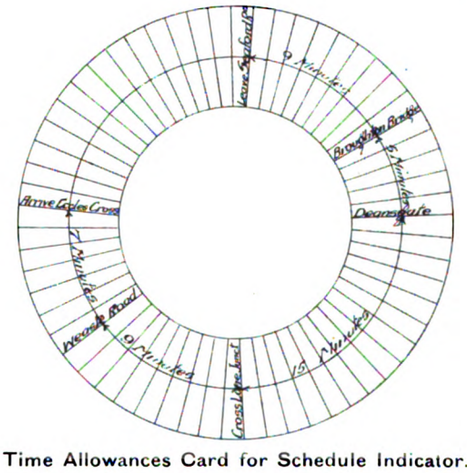
We illustrate below a "time schedule indicator" which has been patented by Mr. G. W. Holford, general manager of the Salford Corporation Tramways system. The main object of this indicator is to better control the running to schedule time of electric cars or other vehicles, a difficulty which seems to be ever present with those officials who have to deal with traffic problems, and one which the grumbling portion of the travelling public is always ready and willing to complain about without troubling to inquire into the circumstances of any irregularity. The patentee believes that the trouble will be very greatly diminished, if not done away with altogether, by the use of the indicator in question.

The centre portion of the indicator is ordinary clockwork of reliable make, and surrounding this is a movable disc, etc. The Traffic Department of a tramway or railway would supply to the drivers along with the indicator a loose cardboard ring, reproduced herewith, to fit on the disc, on which would be marked the exact time the driver is to occupy between various points of his journey. One feature of importance in the case of tramways is that the time allowances between these points would be calculated according to the speed allowances granted by the Board of Trade, and therefore to all intents and purposes the apparatus becomes also a speed indicator. Although the Board of Trade have been urging the adoption of speed indicators on electric cars for some time, and many experiments have been carried out with different types of indicators, none have yet been accepted as capable of meeting with all conditions in sufficient reliability. Mr. Holford hopes, however, that the Board of Trade will approve the present design as one which would reasonably meet their requirements. If need be, the allowed speed for the car between the points could be denoted as a guide to the driver.

The method of working the indicator is exceedingly simple; the driver on arrival at his terminal point will turn the circular disc round until the name of the terminal point appears opposite the exact time he is booked for departure. He then closes the outer glass and proceeds on his journey, noting whether he is arriving at each point as the clock finger points to the

Time Schedule Indicator.

appointed time. He can thus regulate his running, retarding or accelerating the car as may be necessary. On arrival at the opposite terminus he again sets his disc to the starting time. If thought desirable the outward and inward running can be marked on the opposite sides of the ring, which will necessitate it being turned over at each terminus. If the journey extends over 60 minutes a second list of names can be inserted for trips not exceeding two hours, and further alterations could be made for journeys occupying more time than this. Although we understand the indicator has been introduced chiefly for tramways, it is claimed that it will be found exceedingly beneficial for motor omnibuses, railway trains (especially



Time Allowances Card for Schedule Indicator.

for local traffic), etc., and particularly in the case of towns using clocks inside the cars, where the further additional information as to the time the vehicle is due at the main stopping stations would, no doubt, be of much interest and benefit.

The indicator is being placed on the market by the Equipment and Engineering Company, of 2 and 3, Norfolk Street, London, W.C.

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TRAMWAY MEN WITH THE COLOURS.

ROLL OF HONOUR OF THE FALLEN.

In our issues of September 10 and October 8 last we published details of the number of tramway employees throughout the country who had joined His Majesty's Forces, and also particulars as to the allowances made by their employers to the men and their dependents. Since then the appeals by the War Office for more men have been nobly answered by tramway employees. Both corporations and tramway companies have continued to do their part to encourage the men, and the latter can enlist with perfect confidence that their dependents will not be neglected, and that they themselves on their return will be reinstated in their old positions. As a result the figures which, by the courtesy of tramway managers throughout the country, we are now enabled to publish show a very material advance on those given in October last. At that date we published returns from 84 corporations and 59 companies. The number of tramway men in the employment of the corporations who had joined the colours down to the end of September—that was during less than the first two months of the war—was 8,405. The number of the companies' employees who had taken a similar course was 2,285. This gave a total of 10,690. The table which follows shows how greatly these numbers have increased. We have received returns from 89 corporations and from 71 companies.

The figures may be taken as representing the state of matters in the latter part of April, and it will be seen that the total number of corporation tramway employees who have enlisted is 13,981, and of company tramway employees 4,076. This gives a grand total of no less than 18,057. This is no mean contribution which the tramway men of this country have made to the forces which are allied in fighting the German tyranny. The number, in fact, is nearly equal to half an army corps. How the tramway services are able to be carried on without them may to the uninitiated seem a mystery, but much has been done by engaging temporary men, by modifying services, and by the hard and faithful work of the men who remain.

In looking at the column in the table showing for each undertaking the percentage enlisted to the total number of employees, it has to be borne in mind that a large proportion of tramway men, like a large proportion of those in other walks of life, are not eligible for military service, either because they are not within the prescribed ages or because they are unable to pass the severe medical tests. If a percentage could be given of the men enlisted to the total number of tramway men eligible for service, it would, of course, be much higher than even the high ratios shown in the table.

TRAMWAY MEN WITH THE COLOURS.

Corporation Employees.

Corporation.	No. enlisted.	Per cent. total number.
Aberdare	15	35
Aberdeen	103	34
Accrington	24	24
Ashton-under-Lyne	25	26
Ayr	20	25
Barking U.D.C.	16	20
Belfast	156	16
Bexley U.D.C.	17	15
Birkenhead	51	21
Birmingham	993	30
Blackburn	70	25
Blackpool	49	25
Bolton	100	22
Bournemouth	160	34
Bradford	202	15
Brighton	124	54
Burnley	175	48
Burton-on-Trent	20	23
Bury	65	23
Cardiff	152	20
Chester	11	22
Chesterfield	33	30
Colne	16	33
Colchester	32	50
Coventry	52	20
Croydon	110	31
Darlington	23	20
Darwen	18	25
Derby	45	18
Doncaster	33	22
Dover	22	40
Dundee	65	24
East Ham	67	25
Erith	5	10
Glasgow	1,965	32
Gloucester	30	26
Great Yarmouth	45	37
Halifax	119	—
Huddersfield	67	14
Hull	205	33
Ilford U.D.C.	22	—
Ilkeston	13	30
Ipswich	34	25
Keighley	10	7
Kilmarnock	13	32
Kirkcaldy	17	17
Lancaster	7	22
Leeds	487	29
Leicester	278	30
Leith	19	16
Leyton U.D.C.	96	28
Lincoln	3	11
Liverpool	1,000	39
London County Council	2,054	18
Lowestoft	27	50
Luton	18	50
Maidstone	23	43
Manchester	1,668	39
Nelson	12	30
Newcastle	327	29
Newport (Mon.)	35	27
Northampton	24	15
Nottingham	120	20
Oldham	160	36
Pontypridd U.D.C.	27	16
Preston	76	32
Rawtenstall	16	16
Reading	70	35
Rochester	65	25
Rotherham	42	26
Salford	415	34
Sheffield	320	19
Southampton	97	33
Southend-on-Sea	49	27
Southport	34	38
South Shields	37	26
Stalybridge	70	31
Stockport	75	30
Sunderland	58	22
Swindon	17	40
Wallasey	84	38
Walsall	30	20
Walthamstow U.D.C.	50	27
Warrington	22	25
West Ham	202	32
West Hartlepool	24	27
Wigan	42	16
Wolverhampton	52	25
York	40	31
	13,981	

Company Employees.

Company.	No. enlisted.	Per cent. total number.
Aberdeen Suburban	12	50
Airdrie and Coatbridge	9	13
Barrow-in-Furness	26	40
Bath Electric	99	40
Birmingham and District	38	9
Blackpool and Fleetwood	25	25
Blackpool, St. Annes, and Lytham	53	40
Bristol Tramways	718	25
Camborne and Redruth	4	10
Carlisle	10	33
Chatham and District	68	28
Cheltenham and District	32	35
Dartford	4	12
Devonport and District	25	5
Dublin and Lucan	5	12
Dublin United	96	10
Dudley, Stourbridge, and District	25	11
Dumbarton	15	18
Dundee, Broughty Ferry, and District	8	15
Dunfermline and District	29	30
Falkirk and District	22	50
Gateshead and District	37	14
Glossop	13	21
Gosport and Fareham	41	40
Gravesend and Northfleet	20	24
Guernsey	17	30
Hastings	76	28
Isle of Thanet	56	25
Jarrow and District	8	25
Kidderminster and Stourport	21	20
Lanarkshire	116	40
Lancashire United	85	19
Liverpool Overhead	45	13
Llandudno & Colwyn Bay	14	30
London United	416	30
Mansfield and District	28	30
Manx Electric Railway	51	—
Merthyr	20	25
Metropolitan Electric	520	35
Mexborough and Swinton	13	20
Middlesbrough, Stockton, and Thornaby	103	34
Middleton	19	24
Musselburgh and District	21	30
New St. Helens and District	51	30
Norwich	73	28
Nottinghamshire and Derbyshire	8	15
Oldham, Ashton & Hyde	25	16
Paisley District	83	—
Peterborough	5	10
Plymouth, Stonehouse, and Devonport	5	9
Portsdown and Horndean	6	12
Potteries	138	17
Rhondda	80	30
Rothesay	8	15
Scarborough	23	—
Sheerness and District	6	13
South Metropolitan	71	32
Southport	9	17
South Staffordshire	21	16
Sunderland District	28	25
Swansea	94	25
Taunton	6	25
Torquay	59	56
Tynemouth and District	8	17
Tyneside	19	17
Wemyss and District	10	20
Weston-super-Mare	25	30
Wolverhampton	11	10
Worcester	13	21
Wrexham and District	19	31
Yorkshire (West Riding)	64	23
Yorkshire (Woollen Dist.)	45	15
	4,076	

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MEN WHO GAVE THEMSELVES FOR THEIR COUNTRY.

The list which follows is a sad one, but the consolation remains that these brave men died in the service of their country. Their names will be honoured alike by their mates and by their former employers, while the country at large must regard them with the same pride and honour as it regards all others who have fallen. We may be certain also that sympathy and care will be given to their families and dependents.

The names given are those of tramway men included in the casualty lists down to nearly the end of April. The total number of these soldier tramway men who have been killed in action, died from wounds, been lost from ships of the Navy, or who have died from other causes since joining the Forces is 214, of whom 186 were municipal employees and 28 were company employees. One would be relieved that the percentage is not larger were it not for the fact that though the war has lasted nine months many of these men had to go through several months' training, and that many have not yet entered the fighting line.

TRAMWAY MEN'S ROLL OF HONOUR.

Corporation.	Name.	Designation.	Cause of Death.
Aberdeen	Alex. Thomson	Cleaner	Killed in action at Ypres.
Ayr	W. Geddes	Motorman	Lost with the *Cressy*.
	J. Johnstone	Motorman	Killed at Neuve Chapelle.
Belfast	J. Poag	Motorman	Killed at Neuve Chapelle.
	A. P. Smith	Motorman	Killed at Neuve Chapelle.
Birmingham	J. H. Savage	Conductor	Killed in action.
	C. Meigham	Conductor	Killed in action.
	F. W. Collett	Conductor	Killed in action.
	J. Beecher	Conductor	Killed in action.
	R. Gould	Conductor	Killed in action
	W. E. Smith	Conductor	Killed in action.
	H. Townsend	Conductor	Killed in action.
	A. S. Neal	Conductor	Killed in action
	E. Porter	Conductor	Killed in action.
	J. Cottrill	Conductor	Killed in action.
	W. Jones	Conductor	Killed in action.
	A. J. Ford	Conductor	Killed in action.
	A. Woodward	Conductor	Killed in action.
	T. Spencer	Conductor	Killed in action.
	G. Beal	Conductor	Killed in action.
	C. T. Gilbert	Conductor	Killed in action.
	J. Evans	Conductor	Killed in action.
	A. E. Clamp	Conductor	Killed in action.
	G. Brotherton	Conductor	Killed in action.
	R. Neal	Motorman	Killed in action.
	C. Browning	Motorman	Killed in action.
	J. E. Mountford	Motorman	Killed in action.
	W. Fantham	Motorman	Killed in action.
	E. Baxter	Motorman	Killed in action.
	B. Simms	Permanent Way	Killed in action.
	A. Wright	Permanent Way	Killed in action.
	G. Gilbert	Permanent Way	Killed in action.
	F. Turley	Shedman	Killed in action.
	T. L. Lea	Shedman	Killed in action.
	C. H. Pouncey	Overhead	Killed in action.
Blackburn	J. King	Motorman	Killed in action.
	J. H. Gardner	Motorman	Died from wounds.
Bournemouth	—. Osmond	Smith	Lost with the *Hawke*.
Bradford	J. Bamford	Conductor	Died of wounds.
	G. Garnham	Conductor	Killed in action.
	W. E. Harvey	Cleaner	Lost with the *Aboukir*.
	J. Kemp	Conductor	Killed in action.
	A. Padfield	Conductor	Killed in action.
	A. Rushworth	Conductor	Died of wounds.
	J. Craven	Conductor	Killed in action.

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ROLL OF HONOUR—*continued.*

Corporation.	Name.	Designation.	Cause of Death.
Brighton	. Brimley	Conductor	Killed in action.
	. Gander	Conductor	Accidentally shot.
	W. H. Price	Permanent Way Labourer	Lost with patrol boat *Bayano*.
Cardiff	D. McCarthy	Conductor	Killed in action.
Colchester	G. H. Bland	Conductor	Killed in action.
	F. W. Foster	Conductor	Killed in action.
Coventry	W. Foster	Conductor	Died from wounds.
	A. Fleckney	Motorman	Killed in action.
Croydon	F. H. Grayson	Conductor	Killed in action
	A. Woolgar	Apron Cleaner	Killed in action.
East Ham	Chas. Lee	—	Lost with the *Hawke*.
Glasgow	W. Lindsay	Conductor	Killed in action.
	H. Parrott	Conductor	Disease at home.
	J. Carrick	Motorman	Killed in action.
	A. Mess..	Conductor	Killed in action.
	J. Ballantyne	Conductor	Killed in action.
	S. Boyle	Motorman	Killed in action.
	W. J. Carson	Conductor	Killed in action.
	A. Macdonald	Conductor	Killed in action.
	D. Ferguson	Conductor	Killed in action.
	R. Ritchie	Conductor	Killed in action.
	J. Braidwood	Conductor	Killed in action.
	D. Brown	Motorman	Killed in action.
	A. Reid..	Conductor	Killed in action.
	W. Nisbet	Motorman	Killed in action.
	J. Wanless	Conductor	Killed in action.
	R. Gordon	Conductor	Killed in action.
	P. Mauchline	Painter	Drowned in France.
	J. S. Edward	Sub-station Attendant	Disease at home.
	W. O'Prien	Motorman	Killed in action.
	M. McDonald	Conductor	Killed in action.
	A. Fraser	Labourer	Killed in action.
	W. A. Simpson	Conductor	Killed in action.
Gloucester	W. Fisher	Cleaner	Killed in action.
Halifax	R. Turner	Conductor	Killed in action.
	J. Fielding	Conductor	Killed in action.
Huddersfield	A Weldrick	—	Killed in action.
Hull	A. Haldenby	Conductor	Killed in action.
	H. J. Kay	Conductor	Killed in action.
Ilford	H. Willis	Conductor	Killed in action.
Keighley	R. Smith	Motorman	Killed in action.
Leeds	P. Massey	—	Killed in action.
	B. Wright	—	Killed in action.
	W. Ryan	—	Killed in action.
	A. Connor	—	Killed in action.
	H. Dixon	—	Shot by sniper.
London	J. A. Goodwin	Conductor	Killed in action.
	P. Marshall	Conductor	Died of wounds received in action at Jemappes.
	S. Harrison	Labourer	Killed in action.
	W. Challis	Conductor	Drowned in North Sea.
	A. S. Keeler	Car Washer	Drowned in North Sea.
	R. G. Grist	Conductor	Drowned in North Sea.
	H. Arnold	Greaser	Drowned in North Sea.

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ROLL OF HONOUR—*continued.*

Corporation.	Name.	Designation.	Cause of Death.
London—*continued*	H. Rawlings	Greaser	Drowned in North Sea.
	C. H. Boys	Car Washer	Drowned in North Sea.
	A. A. Gaiger	Conductor	Drowned in North Sea.
	S. C. Good	Conductor	Died at Netley Hospital.
	W. J. Plater	Car Washer	Killed in action.
	W. F. Forse	Motorman	Killed near Antwerp.
	A. W. Woods	Cable Hand	Drowned in the English Channel.
	C. Walker	Labourer	Killed in action.
	A. G. Martin	Conductor	Died of wounds received in action.
	F. Greygoose	Car Washer	Killed in action.
	F. H. Field	Slinger	Drowned off the Chilian Coast.
	W. J. Brooker	Labourer	Drowned off the Chilian Coast.
	J. W. Otton	Car Washer	Killed in action.
	T. Foss	Car Washer	Killed in action.
	C. E. J. Martin	Car Washer	Died of wounds whilst a prisoner of war at Werwick, Germany.
	J. W. Horrigan	Motorman	Died while on service at home.
	F. Woodward	Assistant Regulator	Died while on service at home.
	W. H. Ayton	Labourer	Killed in action.
	W. Rathall	Car Washer	Died while on service at home.
	E. H. Palmer	Labourer	Killed in action at Le Gheer, N. France.
	W. Mott	Car Washer	Killed in action.
	T. G. H. Pitt	Motorman	Died of wounds received in action.
	A. F. Samuels	Car Washer	Killed in action.
	G. E. Romer	Rammerman	Killed in action.
	L. Foy	Clerk	Died of wounds received in action.
	H. Hughes	Punch Repairer	Drowned in the Solent.
Leicester	P. W. Bowley	Conductor	Killed in action.
	R. Bell	Conductor	Killed in action.
	T. Chambers	Conductor	Killed in action
	A. Frisby	Conductor	Killed in action.
	W. J. Mason	Motorman	Killed in action.
	G. Sutton	Motorman	Killed in action.
	J. Wolloff	Motorman	Killed in action.
	C. Cave	Motorman	Killed in action.
	E. Edwards	Motorman	Killed in action.
Liverpool	J. Berry	—	Killed in action.
	H. Brooks	—	Killed in action.
	D. Evans	—	Killed in action.
	E. Evans	—	Killed in action.
	J. Harrison	—	Killed in action.
	H. H. Hepworth	—	Killed in action.
	H. Hewitt	—	Killed in action.
	G. H. Jones	—	Killed in action.
	W. Jones	—	Killed in action.
	J. Mackenzie	—	Killed in action.
	A. Mann	—	Killed in action.
	C. R. Mercer	—	Killed in action.
	J. Lundy	—	Killed in action.
	M. Walsh	—	Killed in action.
	H. Watkin	—	Killed in action.
	T. Wadsworth	—	Killed in action.
	G. A. Yeo	—	Killed in action.
Leyton	—. Crump	Conductor	Killed in action.
	—. Aley	Conductor	Killed in action.
Manchester	J. H. Edwards	Driver	Killed in action.
	Wm. Daley	Guard	Killed in action.
	E. Lilley	Handyman	Killed in action.
	H. Saxon	Car Cleaner	Killed in action.
	J. Locklin	Car Cleaner	Killed in action.

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ROLL OF HONOUR—*continued.*

Corporation.	Name.	Designation.	Cause of Death.
Manchester—*continued*	N. Brown	Driver	Killed in action.
	H. Pilkington	Car Cleaner	Killed in action.
	H. Carney	Jr. Pavior	Died of wounds.
	J. H. Palmer	Guard	Died during training.
Northampton	F. Gardner	Conductor	Killed in action.
Nottingham	G. Heathcote	Conductor	Killed in action.
	W. Redshaw	Conductor	Killed in action.
Oldham	J. W. Hopson	Conductor	Killed in action.
	T. H. Hilton	Conductor	Killed in action.
	F. Irving	Conductor	Killed in action.
Reading	A. Attwell	Conductor	Killed in action.
Salford	J. Linney	—	Disease at home.
	F. Bradshaw	—	Died from wounds.
	W. Burns	—	Killed in action.
	J. Dunne	—	Killed in action.
Sheffield	R. Ketterick	Motorman	Died from wounds.
	H. Bates	Motorman	Killed in action.
Southampton	F. Jones	Conductor	Killed in action.
	A. Pearce	—	Killed in action.
Stalybridge	J. Shaw	Motorman	Died during training.
	E. Hadfield	Conductor	Killed in action.
	H. Smith	Conductor	Killed in action.
Swindon	J. W. Law	Conductor	Killed in action.
Walsall	C. E. Martin	Conductor	Killed in action.
West Ham	B. J. R. Lilly	Motorman	Killed in action.
	F. Short	—	Died from pneumonia.
Wigan	P. Liptrot	—	Killed in action.
	S. Jackson	—	Killed in action.

Company.	Name.	Designation.	Cause of Death.
Airdrie and Coatbridge	C. Scott	—	Died from wounds.
Bath Electric	—. Besant	Conductor	Killed in action.
Blackpool and Fleetwood	W. E. Sayle	—	Killed in action.
Chatham and District	W. J. Harling	Motorman	Lost with the *Hawke*.
	—. Fuller	Motorman	Died from wounds.
Dublin United	A. Penny	Conductor	Unknown.
	J. Herron	Conductor	Unknown.
Falkirk and District	J. Baldrick	Conductor	Killed in action.
	A. Grant	Conductor	Died from wounds.
Lanarkshire	J. Smith	Motorman	Killed in action.
Lancashire United	J. Stanley	Conductor	Killed in action.

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ROLL OF HONOUR—*continued.*

Company.	Name.	Designation.	Cause of Death.
New St. Helens and District	J. Edwards	—	Died during training.
	J. Wilson	—	Died during training.
Norwich Electric	F. Smy	—	Died from wounds.
	J. Wells	—	Lost with the *Cressy*.
Nottinghamshire and Derbyshire	A. Conley	Motorman	Killed in action.
Potteries	A. Evans	Conductor	Killed in action.
Scarborough	W. Smith	—	Died from wounds.
Sheerness and District	W. Irving	Stoker	Lost with the *Cressy*.
South Metropolitan	W. Cheeseman	—	—
	W. Packham	—	—
	F. Buckland	—	—
Swansea	J. E. Evans	—	Died from wounds.
	T. J. Taggart	—	Died of fever.
Torquay	J. Horswell	Car Cleaner	Died during training.
Wemyss and District	D. Oswald	Conductor	Killed in action.
Yorkshire (West Riding)	G. Davies	Engine Driver	Lost with the *Bulwark*.
	H. Wylde	Conductor	Killed in action.

TRAMWAYS AND MANUFACTURE OF MUNITIONS.

Cardiff Corporation Offers Government Two Thousand Men.—It is reported that Cardiff City Council, in response to the appeal of the Government, have supplied the names of 2,000 men in their employment whom they will release for service in the manufacture of munitions of war. Of these over 600 are from the tramways department.

Liverpool Offer of Tramway Workshops to Government.—The Tramways and Electricity Committee of Liverpool Corporation have placed at the disposal of His Majesty's Government the whole of their workshops, plant, and power for the production of munitions, or for any other purposes, such as repairs to motor vehicles, etc.

Tramwaymen Agree to Manufacture Munitions.—Newcastle Corporation Tramways Committee have intimated to their employees that the Board of Trade have asked them to release as many men as possible in order that they may be employed in the manufacture of munitions of war. At a meeting of the men held on April 18 it was decided to raise no objection to such a course providing that the men who leave the trams and go into the factories shall be guaranteed reinstatement at the end of the war, and that their work in the factories shall count as tramway service.

Birmingham Corporation Offers One Thousand Men for Munition Work.—Birmingham City Council have approved a scheme whereby over 1,000 Corporation workmen will be released for service in armament factories. The Lord Mayor explained that this action had been taken in response to an appeal from the War Office. The men would return to their situations in the Corporation departments after the war, and no one would lose financially. Already 2,500 employees of the Council are serving with the colours.

Release of Men at Leeds.—The General Purposes Committee of the Leeds City Council have decided to release as soon as possible some 500 men for urgent Government work. Alderman R. A. Smithson presided over the meeting, the Lord Mayor (Mr. J. E Bedford), the town clerk (Sir Robert Fox), and the commercial manager (Mr. J. B. Hamilton) also being present. Mr. Hamilton explained that a short time ago an official from the Local Government Board visited Leeds and interviewed the Lord Mayor and himself on the question of liberating a number of skilled and unskilled workmen in the Corporation service for military work The official presented a request from Lord Kitchener for the immediate assistance of all municipalities in this direction. The committee resolved at once that everything possible should be done to meet the wishes of the Secretary of State for War, and the commercial manager was instructed to consult with the various chiefs of staffs and to prepare a list of every man whose services were not absolutely essential for the maintenance of public health or who could be spared by the Corporation. This has been done, and Mr. Hamilton pointed out that the result would be some diminution in the standard formerly prescribed in the matter of the repairing and cleansing of the streets, the upkeep of the public parks, and the tramways service. As soon as it can be arranged over 500 men working in the Corporation services are accordingly to be released ; of this number 154 will be skilled workmen, such as fitters, turners, millwrights, drillers, platelayers, and so on. Those holding permanent positions will be again employed by the city on the conclusion of the war.

Shortage of Men Causes Route Suspension at Hull.—A special meeting of Hull Corporation Tramways Committee was held on April 14 to consider the situation of the department. The Lord Mayor, who presided, said it was becoming difficult to maintain the existing tram services. No doubt one of the biggest difficulties was to find suitable men to carry on the work. Besides this, the department was in jeopardy in regard to the coal supply, as a twenty-four hours' supply was all they could obtain. Then, again, he had been approached by a Government official, and there was no doubt that the Government were after all the mechanics and fitters they could get. Under the circumstances he thought it would be advisable to suspend the "T.H." service, as that route was not much required. In reply to questions, Mr. McCombe, general manager of the tramways, stated that several evening cars had been taken off some routes He also stated that, as a result of a private conference, the drivers and conductors had voluntarily agreed to work overtime to the extent of twelve hours a week if necessary, for the period of the war, and that they were willing to work for double pay in lieu of taking their week's holiday. The Lord Mayor's proposal that the route named should be suspended was carried unanimously

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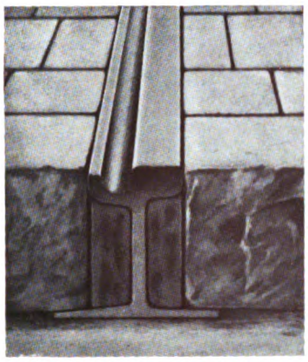
TRAMWAY PARGING BLOCKS.

The difficulties of keeping the paving level with the rail are well enough known. One of the reasons no doubt is that sometimes the space between the head and the base of the rail is not thoroughly filled. The accompanying illustrations indicate some of the benefits to be obtained from the use of a patent parging block made by Shepherd's Parging Block Company, of Rochdale. This block is made in blue ware 9 in. long, and in various heights and shapes to suit different heights of rails and both sides of the rail. It is claimed that the block can be inserted at less cost than ordinary parging material, that it reduces maintenance cost, that it can be used over and over again, and that it never deteriorates. The way in which



Parging Blocks in Place.

Result of Defective Parging.

it supports the paving alongside the rail is clearly indicated in the illustrations. One point put forward in connection with these blocks is of special interest to those responsible for track renewals and maintenance. It is that one gang of paviors using the blocks will do the work of two gangs when the blocks are not used. The saving in labour, apart from anything else, more than covers the cost of the blocks. Time is economised because the paviors have a good vertical solid face against which to pave, and they do not have to look round for special setts. There is also no loss of time on the part of the rammer-man, who does not require to exercise the same care in ramming. The parging block has already been used on several lines in this country, and repeat orders have been received.

SETTLEMENT OF NEWCASTLE DISPUTE.

Serious difficulties have been caused by the fresh demands of Newcastle Corporation Tramways employees, and the question of employing female labour. Both parties agreed to submit the points in dispute to arbitration arranged by Sir George Askwith, chief industrial commissioner. A conference was therefore held on Wednesday, April 28, between representatives of the Government Committee of Production, Newcastle Corporation, and the Amalgamated Association of Tramway and Vehicle Workers. The Government committee consisted of Sir George Askwith (chairman), Sir George Gibb, and Sir Francis Hopwood. Newcastle Corporation representatives were Alderman J. H. Rodgers, Mr. Richard Mayne, Mr. E. Hatton, and Alderman Cail. The men were represented by Alderman Jackson, Mr. P. Millane, Mr. T. Ormiston, and Mr. H. Goodhead. The conference was held in the office of the Chief Industrial Commissioner, and the proceedings were private.

The arbitrators gave the following decision :—" Having regard to the pending discussion as to the introduction of female labour, the arbitrators consider that all matters which are to be submitted to the committee for the purpose of ensuring a settlement until the close of the war shall be deferred until 11 a.m. on Friday, May 7. The arbitrators understand that an arrangement will be concluded between the parties as to the postponing until after the war of all pre-war questions not raised in this inquiry."

In accordance with this arrangement, a conference was held on Saturday, May 1, between Newcastle Tramways Committee and representatives of the tramway employees, and agreement was arrived at on all points excepting the terms of female employment and amount of war bonus. These questions in dispute were submitted to the arbitrators on Friday, May 7. The Arbitration Court sat from eleven o'clock until shortly after 2.30 p.m. The Court reserved judgment on war bonus, and on the question of female employment decided as follows :—The committee consider (1) that it is inexpedient that previous to the trial of a proper working scheme the final arrangements as to wages should be laid down on the lines suggested by either party ; (2) that a proper working scheme should be given a trial and experience gained by actual working ; (3) that the rates temporarily paid for female labour should not be less than 6d. per hour. Nothing in this statement or in the course of the trial of the scheme shall be taken to prejudice in any way the position of the present employees of the Corporation. Either party to be able to apply to the Committee on Production for further consideration.

"WITTON" SECTIONING SWITCH FOR TRAMWAYS.

At the request of a large municipality, the General Electric Company, Limited, Witton, Birmingham, and 67, Queen Victoria Street, London, E.C., has constructed a sectioning switch for pole mounting on the tramway circuits. This device consists of a 300-ampere "Peel" switch fixed in a cast-iron case, the case being of such a length that the switch can be fully opened and the lid closed. The lid is provided with a spring lock and a special key.

"Witton" 300-ampere tramway sectioning switch.

The method of fixing this switch to the pole is as follows :—The sides of the switch case extend some distance beyond the back, and these sides fit on to the pole. The device is clamped to the pole by two steel bands, the ends of which are screwed and provided with nuts and washers. These pass through the horizontal apertures seen at the top and bottom at the back of the case, and the two nuts tighten down on the metal-work, and thereby secure the case to the pole.

The General Electric Company, Limited, has in hand larger sizes, and will be pleased to meet the requirements of any tramways authority.

THE UNDERWOOD RAIL JOINT.

A new form of rail joint which is finding favour in the Far East and promises to be adopted by various Australasian tramways is that manufactured by the Autogenous Welders of Australasia, of Newcastle, New South Wales. It was first taken up by the Shanghai undertaking. It is claimed that mechanically the joint is perfect because the load is taken by the welding plates. Electrically the joint is of 100 per cent. efficiency as the weld of the two plates to the rails covers about 100 sq. in. Taking it for granted that the welded joint in general is superior to the fish-plate joint in general, the Underwood welded joint is intended to overcome such drawbacks to other welded joints such as cost and want of reliability when applied to old track.

The joint consists essentially of a pair of specially shaped fish plates clamped into the rail ends to within about $\frac{5}{32}$in. of the web ; the edges of the fish plates are then electrically arc-welded to the rails. This joint, as proved by tests, has great strength and rigidity and, when applied to old track, the " cupped " or battered portion of the rail tread is arc-welded across ; the metal added to the tread is usually a low-grade tool steel of about the same carbon content as the rail itself ; the roughness caused by the welding is afterwards ground down to the true level of the rail.

The claims made for the joint are briefly :—(1) A boltless and bondless joint in which the load is taken by the plates, the welding around the plates taking the place of the bolts and usual copper bonds ; (2) a joint perfectly rigid and stronger than the rail itself ; (3) a joint that remains good as long as there is life in the rails ; (4) a joint in which the conductivity is 100 per cent. and remains so ; (5) a joint which presents a perfect and lastingly smooth running surface ; (6) a joint which may be applied to old track with perfect success no matter to what extent the rail treads are battered at the joint.

It is further claimed that the joint is applicable to any type of tramway rail and that no disturbance of rail foundation is necessary. Current for the welding is taken from the overhead trolley wire. The rate at which it is possible to instal the joints is, roughly, two men one joint per hour.

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WOMEN AS EMERGENCY CONDUCTORS.

In order to set free for service in H.M. Forces as large a number of conductors as possible, the tramways authorities in many of the larger towns have sanctioned the employment of women as "emergency" conductors during the war. It is understood that such employment is of an emergency character only, and that after the war the men will return to their old positions. Glasgow was the first city to give women conductors a trial, and they appear to have done the work so well that their number has been largely increased. Cardiff followed the example of Glasgow, and since then the plan has been approved in Manchester, Salford, and many other towns. It is not intended that the women shall work under exactly the same conditions as male conductors. Their hours of employment will be shorter, and they will probably not be put on late cars. There has naturally been much criticism of the innovation, but those responsible for its introduction have very rightly decided that objections which in time of peace would be unanswerable should have no weight in the general crisis. There can, in fact, be only one criterion in these days in regard to any proposal—will it tend to help the progress of our great cause? If so, it should be accepted without complaint.

Women Conductors at Glasgow and Cardiff.

LONDON UNDERGROUND POSTERS.

The latest posters published by the Underground Electric Railways of London are from an artistic point of view admirable examples of the excellent work which those responsible for the underground

"Springtime."—A London "Underground" Railway Poster.

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propaganda are doing. The large poster depicting "Springtime" (which is here reproduced) was drawn direct on to the stone by Mr. H. Becker. The "Zoo" poster, another striking subject, is the work of Mr. Semoto, a Japanese artist. Two other illustrations include a stirring patriotic bill entitled "The Only Road for an Englishman"—drawn by Mr. G. Spenser Pryse—and a work entitled "Rest," which is intended to explain the idea outlined by the larger "Springtime" poster. These bills are now to be seen on most Underground stations, and are attracting much attention by reason of their originality and good workmanship.

FINANCIAL REPORTS AND MEETINGS.

Dunlop Rubber Company.—An interim dividend on the ordinary shares at the rate of 10 per cent. per annum has been paid.

Dennis Brothers, Limited.—The directors have recommended an interim dividend at the rate of 7½ per cent. per annum for the half-year ended March 31.

Barsi Light Railway.—An interim dividend of 3 per cent. has been paid, together with a bonus of 1 per cent. (8s. per share in all) in respect of the year to March 31, 1915.

La Plata Electric Tramways Company.—The accounts for the year 1914 show a surplus, after providing for debenture interests, of £6,614, which it is proposed to carry forward.

Loss on Heywood Tramways.—In the annual report of Heywood Corporation Tramways Committee it is stated that the accounts show a loss of £1,042 on the year's working, as compared with a profit of £85 in the previous year.

Brazilian Traction, Light, and Power Company.—A quarterly dividend of 1½ per cent. on the issued ordinary capital stock of the company, payable in Toronto June 1, has been declared. A year ago the dividend was at the same rate.

Vickers, Limited.—The directors have decided to place £250,000 to general reserve, and recommend a final dividend of 1s. 6d. per share (free of tax) on the ordinary shares, making 2s. 6d. per share, or 12½ per cent. for the year. The amount carried forward is £228,876.

Colombo Electric Tramways and Lighting Company.—The directors in their report recommend that a dividend of 10 per cent. free of income-tax be paid for the year 1914; that £8,010 be carried forward, and that £20,000 be transferred to general reserve and renewals fund.

John I. Thornycroft, Limited.—The following dividends have been declared:—Three per cent. on the preference shares, making 6 per cent. for the year, and 8 per cent. on the ordinary shares. In addition, substantial amounts have been transferred to reserve and in reduction of goodwill account, £10,000 being carried forward.

Thomas Tilling, Limited.—The profits for the past year amounted to £50,036, and £16,782 was brought forward. The directors transfer £3,132 to reserve for depreciation of investments, write off the expenses of issue (£9,000), and recommend a dividend of 5 per cent. free of income tax on the ordinary shares, carrying forward £17,186.

Croydon Tramways.—At a recent meeting of the Town Council, Alderman Allen, chairman of the Tramways Committee, mentioned that the receipts of the tramway system for the financial year just concluded show an increase of £2,914 over those of the preceding year. The chairman regarded this as fairly satisfactory in view of the exceptional circumstances.

Southport Tramways Company.—The annual report of this company shows that the total revenue, including £106 brought forward, amounted to £17,142. After deducting all expenses, including £5,573 payable to Southport Corporation under agreements, £1,053 for maintenance, and a provision of £500 for renewals, there remains a balance of £650. The directors recommend that £500 be placed to reserve, leaving £150 to be carried forward.

Birkenhead Corporation Tramways.—In presenting the yearly accounts of Birkenhead Corporation to a meeting of Council held on April 16, Alderman Oldham, chairman of the Finance Committee, stated that for the first time since the inception of the tramways it had been deemed advisable to apply the sum of £1,260 to the relief of the rates. In all but four years the undertaking had paid its way, and the available surplus had invariably been transferred to the renewals fund, which at the close of last year had accumulated to £21,955.

Cork Electric Tramways and Lighting Company.—The directors' report for 1914 states that the balance sheet and revenue account show a revenue of £61,604; expenses, £37,958; interest on debentures, £4,600; balance, including £1,352 brought forward, £20,398. Of this amount £6,163 was paid on July 1 and January 1 for the half-yearly dividends on the 5 per cent. cumulative preference shares, £6,500 added to reserve for depreciation and renewals, £1,804 written off as per revenue account and the directors propose to dispose of the remainder as follows:—£3,450 to dividend of 3 per cent. on ordinary shares, £2,480 to revenue new account.

The Metropolitan Electric Tramways are feeling the effects of the war in a falling revenue. Mr. Garcke stated at the annual meeting of the shareholders that up to August 1 last year the traffic receipts were £7,000 higher than those in the corresponding period of 1913. By the end of 1914, however, the increase had been turned into a decrease of £8,500. Apart from the curtailed running, receipts had been reduced owing to the earlier closing of shops and the restricted street lighting, there being very little traffic after ten o'clock at night in the districts served by the company's trams.

Plymouth Corporation Tramways.—The annual report of the general manager for the year ended March 31 shows total receipts of £44,376 5s. 7d., compared with £42,014 16s. 6d. in the previous year, an increase of £2,361 9s. 1d. The total expenditure for the year amounted to £41,286 15s. 10d., as against £38,269 4s. in the previous year, an increase of £3,017 11s. 10d. Last year's expenditure, however, included £2,324 for new trucks and electrical equipment, and there was no expenditure under this head in the previous year. During the year the cars travelled 837,243 miles, and carried 9,807,583 passengers, compared with 838,142 miles run and 9,332,583 passengers carried in the previous year, a decrease of 899 in the mileage run, but an increase of 535,000 in the passengers carried.

Kidderminster Electric Lighting and Traction Company.—In the directors' report for the year 1914, the accounts of the two departments are stated separately. Lighting Department:—Net receipts were £4,260; adding dividends receivable, £1,955, and £204 brought forward, gives a total of £6,420. After deducting expenses, reserve for doubtful debts, interest of temporary loans, and debenture interest, there remains a balance of £2,468, which the directors propose should be allocated as follows:—To reserve, £750; to dividend on cumulative preference shares for the year 1914, £1,500; to be carried forward, £218. Traction Department:—The profit on the year's working, after providing for renewals, is £1,964; addition of £129 brought forward makes a balance of £2,093, which has been apportioned as follows:—To reserve fund, £500; to payment of a dividend at the rate of 2½ per cent. on shares, £1,470; to be carried forward, £163.

Bradford Tramways. The annual report of Bradford Corporation Tramways for the year ended March 31 indicates that the prosperity of the city has not been seriously affected by the war. Traffic receipts amount to £319,642, an increase of £10,849 as compared with the last financial year. Car mileage totals 6,371,442, which shows an increase of 115,564 miles over last year. The average receipts per car-mile worked out at 12·04d., as against 11·84d. for the previous year, giving an increase of 0·20d. Passengers carried numbered 69,932,468, or 2,257,302 more than in 1913-14. The consumption of electrical energy for traction totalled 12,108,321 units, an increase of 257,423; and the units work out at 1·900 per car-mile, as compared with 1·894, showing only an inappreciable increase of 0·006 on the year's working. Extensions have been made during the year on both the ordinary system and the railless systems of the city.

Calcutta Tramways Company. The directors' report for the year 1914 states that the profit for the year, including interest on investments and deposits, amounts to £109,035. Addition of £8,405 brought forward makes £117,440 available, which it is proposed to appropriate as follows:—A final dividend of 6s. 6d. per share, making 9½ per cent. for the year; transfer to reserve for depreciation, etc., £15,000; contribution to staff provident fund, £1,258; balance to be carried forward, £7,566. The reserve at the commencement of the year stood at £79,992. After deducting therefrom £14,442 written off for renewals during the year, and adding £15,000 proposed to be allocated as above, it will stand at £80,550. In view of the exceptional taxation rendered necessary by the war, and which the Government have been compelled to adopt, income-tax will in future be deducted from all dividends paid by the company. Presiding at the annual meeting of shareholders in London on April 30, Sir Henry Kimber said their earnings for the last seven years had been on the up grade, and a year ago he was able to report a record year. For the first seven months of the past year the earnings showed a gross increase over the corresponding period of the previous year of £9,000. Since then, however, that £9,000 had been swept away, with the exception of £1,032. The report was adopted.

MANCHESTER CORPORATION TRAMWAYS.

Manchester Corporation Tramways Committee decided at a meeting held on April 20 to contribute the sum of £100,000 towards the relief of the city rates. The Tramways Department has proved the most lucrative in recent years of all the trading concerns of the Corporation, and the extent of its dealings may be seen from the estimates for the year. The approximate expenditure for the year ending March 31 last was £901,832, and the estimate £950,600, this sum including £100,000 given to the city rates. The approximate income for the year was £901,832, and the estimate £950,600. For the year 1915-16 the expenditure is estimated at £882,500, and the income from traffic and other revenue £878,700.

Last year's traffic expenses, including superintendence, wages of drivers, and other traffic employees, amounted to £273,422; the new

(*Continued on page* 358.)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ...	May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington ...	Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne..	Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	May 15, 1914	Sept., 1901	,,	9 30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ...	Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ...	Mar. 25, 1914	Mar., 1899	,,	24 63	408,174	342,474	65,700	335,735	13,544	248,578	182,557	2,146	68,192	3,147	71,339
Blackpool ...	Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford ...	Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	Mar. 31, 1914	June, 1903	,,	21 2 (b)13 21	407,800	284,745	123,055	286,989	13,650	255,455	49,013	(l)29,518	69,745	335	70,080
Chester	Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ...	Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ...	Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington ...	Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	25,338	6,806	12,976	261	13,237
Darwen	Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	Mar. 31, 1914	July, 1904	E. H.	22 20	239,980 ...	239,980 ...	... ...	245,332 ...	11,026 ...	177,676 ...	67,656 ...	(l)32,356 ...	E51,126 H 429	1,048 19	52,174 448
Doncaster ...	Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham ...	Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ...	Mar 31, 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock ...	May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ...	May 15, 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster ...	Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool ...	Dec. 31, 1914	Nov., 1898	E.	124 0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ...	Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ...	Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ...	Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.) .	Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ...	Mar. 31, 1914	Jan., 1901	,,	...	720,140	667,705	52,435	667,705	...	410,091	237,501	68,372	172,731	2,648	175,379
Oldham	Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth ...	Mar. 31, 1914	Sept., 1899	,,	15 0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ...	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall ...	Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	Mar. 31, 1914	May, 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham ...	Mar. 31, 1914	Jan., 1903	,, R.T	12 2 ...	342,200 ...	183,775 ...	158,325 ...	184,859 ...	14,537 ...	152,244 ...	33,481 ...	24,632 ...	44,495 5,757	70 ...	44,565 5,767
Salford	Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ...	Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ...	Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ...	Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l)26,881	37,744	586	38,330
Staly'ge, H., M., D.	Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport ...	Mar. 31, 1914	Aug., 1901	,,	27 5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey ...	Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1914	Dec., 1902	,,	19 44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow ...	Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington ...	Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham ...	Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.)...	Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	Mar. 31, 1914	Nov., 1905	E.	98 54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	Mar. 31, 1914	July, 1902	,,	(e) 29 62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry ...	Mar. 31, 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	May 31, 1914	Oct., 1898	,,	193 40 (b) 2 53	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
Huddersfield ...	Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester... ...	Dec. 31, 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	Mar. 31, 1914	... May, 1903	H. C.E	13 73 277 26	(c)	(c)	(c)	... 13,028,119	... ...	... 9,923,528	... 3,370,966	... 730,346	21,145 2,181,344	480 65,698	21,635 2,247,042
N'castle-on-Tyne	Mar. 31, 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ...	Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth ...	Mar. 31, 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	Mar. 25, 1914	Sep., 1899	,,	79 3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	Mar. 31, 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Additional lines leased and worked. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1½ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit.					Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal.	Sundries.	Total.	
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	17,263	4,947	14,659	10,301	47,170	24,169	...	4,803	15,176	179	...	...	20,158	+ 4,011
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	15,735	5,416	7,011	7,684	35,846	34,234	151	7,904	4,895	462	3,124	(w) 12,000	28,385	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	..	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906	5,499 81	8,610	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	44,898	15,328	19,776	28,420	108,422	66,957	...	14,124	20,270	...	1,000	550	35,944	+ 31,013
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1, 310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	...	...	...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,294	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	h) 6,336	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,005
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,526
N'castle on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses.
(n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account.
(r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit motor char-a-banc. (z) Includes £6,519 rent of leased lines. † £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	4,011	...	...	14·08	13·46	3·41	·97	2·93	2·06	9·37	66·10	7·37	1,901,668	1·3	1·64
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·38	10·26	2·315	·769	1·213	1·252	5·549	50·44	4·297	2,037,620	1	1·252
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	445	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E. 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	7,013	24,000	...	11·87	3·04	1·04	1·34	1·92	7·34	61·82	5·42	5,359,804	1·25	1·51
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale ...	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ... R.T....	4,287 1,009	750 ...	12·54 10·74	12·52 10·74	2·92 2·44	·87 ·76	2·22 2·68	2·79 1·23	8·80 7·11	70·15 66·20	6·01 5·88	1,731,184 120,303	1·375 1·375	2·03 1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport ...		250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	2,479		1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838,649	1·68	1·164
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1 1/16	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758.296	1·56	1·052
York		2,524		9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1.009.827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	...	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21 H. 8·15	8·94 7·97	3·32 4·07	·76 1·39	1·41 1·53	1·01 4·40	6·50 11·39	70·55 139·72	5·49 11·39	154,048,461 ...	·601 ...	2·63 ...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10.702	(i) 3.000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7.032	2,000	30.581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18.601,705	446	1·933
Wellington, N.Z.	15.431	...		16·303	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769.149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS.

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Popular'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		d.	Miles.	d.	Miles.			
Aberdeen ...	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10/3	·508	1·80	·58	7·5	703	54	77
Accrington ...	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11/1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24 4	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,149,462	12,731,532	11·07	1·28	63·15	105	2,751	6/10	·88	1·25	·76	7·5	448	32	61
Blackpool ...	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24/9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·831	7·3	2,340·5	151	248
Brighton ...	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6·3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,631,126	15,831,487	10	1·06	123·5	98·80	2,028	10 10	·543	1·24	·85	8·51	483·83	45·26	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5·5	·78	1·38	·75	7·33	126	7	17
Colchester ...	43,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4/8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon ...	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9·10	·871	2·05	·80	8·14	942·23	59	75
Darlington ...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935				...	1·35	1	1	..	...	..	3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8/2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax ...	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12/4	·867	1·30	·87	7·23	853·93	77	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,236	5/7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52·8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·81	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	183	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6/11	·532	1·75	·428	7	90	5	8
Liverpool ...	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	..	...	..	662
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	262,000	3,843,669	40,535,874	11·43	1·02	155	92·72	...	13/2	·642	1·70	1	6·86	...	105	135
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	...	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd ...	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10/9	·751	1·12	·88	9	247·5	15	24
Rochdale ...	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham ...	64,000	E 852,639	9,874,231	11·58	1·08	154·3	...	3,701	13,9	·76	...	...	...	...	...	...
	...	R T 128,685	471,690	3·67	2·72	...	...	...	...	1·92	...	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543,941	13,162,224	8·52	1·23	108	77·38	3,624	11/1	·82	1·25	·55	...	...	...	70
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11 2	...	...	...	..	..	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·8	430	37	38
Warrington	86,000	458,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham ...	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·81	7·75	1,235	95	118
Wigan ...	200,000	1,500,846	14,295,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1 96	·43	8·75	2,350	257	289
Bexley ...	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow ...	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds ...	525,000	9,204,331	93,679,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·86	3,339	222	318
Leicester ...	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·48	8	1,451	...	160
London ...	...	E 58,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·05	17,728·8	1,335	1,722
		H 636.933	,613,781	10·38	·77	...	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6/4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9/2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16/1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·89	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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TRAMWAY AND OMNIBUS SHARE LIST.

Specially Compiled for "The Tramway and Railway World."

Amount Ranking for Dividend.	Shares.	Name.	Div'd. Prev. Half-year.	Div'd. Last Half-year.	Quotations, May. 5.	Movement Since Feb. 4. Rise.	Fall.	Latest Business Done. Price.	Date.	Yield on Buying Price. £ s. d.	Dividend Due. (Final in Italics.)	Quotations, Jan., 1908, to Mar. 5, 1915. Highest	Lowest
$6,000,000	$100	Alabama Traction 5% Bonds	5	5	61–63	+10	...	62½	May 5	...	Mar., Sept.	86	49
640,000	5	Anglo-Argentine Tramways 5½% Cum. 1st Pref.	2/9	2/9	4⅜–4⅝	+ 1/16	...	87/6	April 30	5 19 0	Jan., July.	5⅛	4
500,000	5	Do. do. 5½% Cum. 2nd Pref.	2/9	2/9	3¾–4	+ 1/16	...	77/6	April 30	6 17 6	June, *Dec.*	5½	3½
1,500,000£	...	Do. do. 5% Deb. Stock Red.	5%	5%	89–91	+ 3	...	89½	May 5	5 13 9	June, Dec.	105½	86
325,532£	Stk.	Auckland Elec. Trvs. Co. 5% Mort. Deb. ..	5%	5%	97–100	+ 1	...	99⅞	April 22	5 0 0	Jan., July.	107	96
75,000	1	Bath Electric Tramways 5% Cum. Pref. ...	6d.	6d.	9/16–11/16	...	...	12/1½	April 27	7 5 6	*Jan. & July*	1⅛	1/16
334,696£	Stk.	Birmingham Dist. Pow. & Tract. 4½% 1st Deb....	4½%	4½%	82½–83½	...	...	83	Jan. 15	5 7 9	Jan., July.	96	77
15,000	10	Blackpool and Fleetwood Tramways	12/-	for yr.	12–13	...	...	13⅞	June 29	4 12 6	Feb., Aug.	16	12
60,000	10	Bombay Elec. Supply & Trys. Co. 6% Cum. Pref.	6/-	6/-	10½–11	...	...	10 15/16	Feb. 19	5 9 3	Feb., Aug.	12	7⅛
1,005,614	$100	Brazil Traction...	6%	6%	56–58	+ 7	...	56½	May 5	10 11 3	Fb.My Ag.Nv.	105½	49
75,000	5	Brisbane Elec. Tramways Investment Co. Ord.	4/-	4/-	7–7⅛	+ ¼	...	7¼	April 30	5 6 9	*May*, Oct.	9⅛	3 7/16
75,000	5	Do. do. do. 5% Cum. Pref.	2/6	2/6	4¾–5	...	...	4 13/16	April 29	5 0 0	*May*, Nov.	5⅜	4⅛
50,000	10	Bristol Tramways and Carriage Co.	5	4	6–6½	+ ¾	...	6 11/16	April 16	6 18 6	*Feb.*, Aug.	14½	5
50,000	10	Do. do. do. 4% Cum. Pref.	4	4	7–7½	...	...	7⅛	April 15	5 10 6	Jan., July.	9¼	6⅜
800,000£	Stk.	British Columbia Electric Railway Def. Ord. ..	8%	...	49–51	...	—20	49⅜	May 5	...	May, Nov.	156	40
800,000£	Stk.	Do. do. Pref. Ord.	6%	6%	55–7	...	—14	55	May 5	8 18 6	Feb., Aug.	132⅛	49½
800,000£	Stk	Do. do. 5% Cum. Perp. Pref.	5%	5%	78–80	...	— 8	79⅜	April 27	6 5 0	Jan., July.	114	75
1,070,097£	Stk.	British Electric Traction 6% Prefd. Ord. ...	...	...	7–12	...	— 3	10	May 5	...	Apr., *Oct.*	19	7
403,503£	Stk.	Do. do. 6% Cum. Pref. ...	6%	6%	73–76	...	...	75	April 27	7 18 0	Feb., *Aug.*	95½	73
1,464,245£	Stk.	Do. do. 5% Perp. Deb. ...	5%	5%	83–85	...	— 3	83½	April 20	5 17 9	April, Oct.	101	82½
439,796£	Stk.	Do. do. 4½% 2nd Deb. Red. ...	4½%	4½%	72–75	+ 1	...	75½	April 28	6 1 9	May, Nov.	84	58
246,625£	Stk.	Buenos Aires Port & City Trys. 6% 1st Mt. Deb.	6%	6%	68–73	...	...	71	Mar. 24,14	...	Feb., Aug.	103	61
623,270£	Stk.	Buenos Ayres Lacroze Trys. Stg. 5% 1st Mt.Deb.	5%	5%	98–100	...	...	99½	April 21	5 0 0	Mar., Sept.	103	89
137,610	5	Calcutta Tramways Ord.	3/-	6/6	6⅜–6⅝	+ ¼	...	6½	April 29	7 7 3	*Apr.*, Oct.	7⅜	4
47,295	5	Do. 5% Cum. Pref.	2/6	2/6	4⅛–5⅛	+ 1/16	..	4 15/16	April 29	4 17 6	Jan., July	5⅜	4⅛
491,222	1	Cape Electric Tramways	6d.	for yr.	7/16–9/16	...	...	10/-	April 6	4 17 9	Feb., *Nov.*	1/2	1/8
15,000	10	Carthagena and Herrerias Steam Tramways ...	4/-	May, '14	2¾–3½	...	...	62/6	Mar. 3,14	5 14 3	April.	7	2¾
248,000	5	City of Buenos Ayres Tramways (1904) ...	2/6	2/6	5–5¼	...	...	5¼	May 4	4 15 3	Fe My.Au.No	6	4⅛
120,000£	Stk.	Colombo Elec. Trys. & Ltg. 5% 1st Mt. Deb. ...	5%	5%	90–93	...	— 4	93	July 6	5 7 6	May, Nov.	101	87
11,500	10	Cork Electric Tramways and Lighting Co. ...	...	6/- ann.	4–4½	...	...	4 1/16	Dec. 23	6 13 6	*Mar.*	10	4
12,327	10	Do. do. do. 5% Cum Pref.	5/-	5/-	6½–7	...	...	6⅝	Feb. 26	7 3 0	Jan., July	10⅜	6½
3,000	10	Dublin and Lucan Elec. Railway 5% Cum. Pref.	5/-	Nil	6–7	...	...	9	Aug. 25/10	..	Sep.15, Mar.15	9½	6
60,000	10	Dublin United Tramways Co. (1896), Ltd., Ord.	5/-	5/-	10¼–10⅜	...	...	10⅜	April 26	4 13 0	Feb., Aug.	14	10 1/16
60,000	10	Do. do. do. 6% Cum. Pref.	6/-	6/-	12–12¼	...	...	12¼	April 29	4 18 0	*Feb.*, Aug.	14	11⅛
268,235	10/-	Hastings and District Elec. Trys Ord.	...	...	3/16–3/32	...	...	1/3	Apr.17/14	...	...	3/16	1/32
80,000	1	Do. do. 6% Cum. Pref. ...	6%	6%	9/16–5/8	...	— 1/16	10/9	Apr.17/14	10 3 3	...	5/8	1/16
125,000£	Stk.	Do. do. 4½% Deb. Stk. Red.	4½	4½	60–65	...	— 5	65	Apr.15/14	6 18 6	April, Oct.	100	60
$9,634,000	$1,000	Havana Elec. Rly. Co. Con. Mort. 5%	5%	5%	87–90	...	...	88⅛	Jan. 14	5 13 9	Feb., Aug	105	80
195,000£	100	Hong Kong Tramways Co. 5% Mt. Deb. ...	5%	5%	85–90	...	...	82½	July 29	5 12 6	May, Nov.	92	75½
20,000	10	Imperial Tramways Ord.	Nil	4% year	3⅜–3⅝	...	...	3	Mar. 4	11 0 9	Feb., Aug.	9⅜	2½
20,000	10	Do. 6% Cum. Pref.	6%	6%	6½–6⅝	...	...	6 7/32	Ju.28/09	9 4 9	Jan., July.	9⅝	2⅝
30,000	5	Isle of Thanet Elec.Try.& Ltg. Co.5% Cum.Pref.	3/-	Dec. '13	1⅜–1⅝	...	— ⅜	32/6	April 12	...	*Mar.*, Sept.	3	0⅞
170,000	1	La Plata Elec. Trys. Co. 6% Cum. Pref. ...	7½d.	Apr. '15	3/4–7/8	...	...	17/6	Jan.14/14	...	*April*. Oct.	1 1/16	0½
30,800	10	Lanarkshire Tramways	6/6	6/-	9⅜–9⅝	...	— ¼	9¾	April 27	5 16 6	Feb., Aug.	10⅜	9⅜
250,000£	Stk.	Lancashire United Trys. 5% Prior Lien Deb....	5%	5%	84½–86½	...	...	87½	June 15	5 15 9	Jan., July.	95	76
634,026	1	Lisbon Electric Tramways Ord.	7½d.	7½d.	1 1/16–1 1/16	...	...	25/-	June 30	5 1 3	*July.*	1 1/16	⅛
425,553	1	Do. do. 6% Cum. Pref ...	7½d.	7½d.	⅞–1	...	...	21/-	June 5	6 0 0	Jan., July.	1¼	1/16
1,833,136	1	London and Suburban Traction Ord.	1½d.	for yr.	1/16–3/16	...	— 1/32	3/-	May 3	2 13 6	Aug.	5/9	1/3
1,581,059	1	Do. do. do. 5% Cum. Pref.	5	5	⅝–¾	...	— 1/16	8/6	April 29	10 0 0	Feb., Aug.	14/-	4/6
1,000,000£	Stk.	London General Omnibus 4½% 1st Deb.	4½	4½	95–99	...	...	97	May 5	4 11 0	Jan., July.	98⅛	92½
1,000,000£	Stk.	Do. do. 5% Cum. Income ...	5	5	87–89	+ 4	...	87½	May 5	5 12 6	Feb., Aug.	95	84
1,649,930£	Stk.	London United Tramways 4% 1st Deb. Stk. ...	4	4	51–53	...	...	52¼	April 30	7 11 0	*Jan.*, July.	82	49⅛
63,430£	Stk.	Madras Elec. Trys. (1904) Ltd. 5% Deb. Red. ...	5%	5%	99–101	...	...	101⅛	Oct.16/14	4 19 0	Jan., July.	105	86
20,000	5	Do. Do. Do. 6% Cum. Pref. ...	6%	6%	4⅜–5⅛	+ ⅜	...	5	April 9	5 17 3	Ma., Sept.	5⅜	87/6
300,000£	100	Manaos Trys. & Ltg. Co. 5% 1st Debs.	5%	5%	69–71	...	...	69	Mar. 30	7 1 0	Jan., July.	97	68½
$4.785,000	$1,000	Manila Elec. R. R. and Ltg. Corp. 5% Gld. Bds.	5%	5%	96–98	...	...	96¾	Mar. 8	5 4 9	Mar., Sept.	104⅜	84
60,000	1	Mansfield & District Trys. Ltd. 6% Cum. Pref.	7½d.	7½d.	1/16–1 1/16	...	...	20/3	Jan. 1	5 13 0	Mar., Sept.	1 1/16	¾
$20.000,000	$100	Mexico Tramways Common Stock	$1⅞	Nov. '13	40–42	+ 5	...	42	May 4	...	Fb.My.Au.No	151⅛	30
$3,840,000	...	Michigan Untd Rys. Co. 5% 1st Debs & Refdg Bds	5%	5%	88–90	...	...	90	April 28	5 14 3	May, Nov.	101⅛	85⅛
600,000£	100	Montreal Street Rly. 4½% Ster. Debs.	4½%	4½%	99–100	...	— 3	100	May 4	4 10 0	Fe.My.Au.No.	107	97
150,000	1	National Steam Car	5%	year	7/16–9/16	...	— ⅛	10/9	May 5	8 18 0	Dec.	39/9	8/9
50,000	1	Oldham, Ashton, and Hyde Elec. Tramways Ord.	6 year	Nil	12/– –13/–	...	— 1/–	14/-	Apr.2/13	...	Mar., Aug.	18/9	11/6
50,000	1	Do. do. do. 5% Cum. Pref.	5%	5%	13/– –14/–	...	...	14/6	Jan. 9	7 3 0	Feb., Aug.	17/-	12/4½
77,893	5	Para Elec. Rly. and Ltg. Co., Ord.	6/-	year	4–4½	...	...	4 3/16	June 10	6 13 6	May, Nov.	8	4
245,000	1	Potteries Electric Traction Ord.	2½	for '14	1/16–3/16	...	— 1/32	4/9	Mar. 12	8 0 0	April.	⅜	⅛
245,000	1	Do. do. 5% Cum. Pref. ...	6d.	6d.	⅛–¼	...	...	10/6	April 20	8 0 0	*Feb.*, Aug.	⅜	1/16
124,560	1	Provincial Tramways Ord.	8d.	10d.	⅛–1	+ 1/16	...	19/–	April 28	7 10 0	May. *Nov.*	1 1/16	13/–
10,000	10	Do. do. 6% Cum. Pref.	6/-	6/–	10–10½	...	— ⅜	10	Mar. 3	5 17 3	June, *Dec.*	11	9
50,000	5	Rangoon Elec. Trys. & Supply Co. 6% Cum. Pref.	3/-	3/-	5–5⅛	...	...	5¼	April 27	5 9 3	June, Dec.	6	4⅞
32,000	10	Shanghai Elec. Construction Co.	14/-	year	12½–13⅜	...	...	12⅞	June 27	5 3 9	May.	13 1/16	6
330,400£	Stk.	Singapore Elec. Trys. Ltd., 5% Debs. Red. ...	5%	5%	80–82	...	— 10	80⅜	April 27	6 2 0	Mar., Sept.	92	61
91,720£	Stk.	Southern Elec. Trys. of B.A., 1st Mt. Deb. ...	5%	5%	98–101	+ 1	...	99½	Jan. 22	4 19 0	Feb., Aug.	102	90
471,500£	100	Toronto Rly. Co. 1st Mt. 4½% Stg. Bonds ...	4½%	4½%	94–96	+ ½	..	95¼	April 27	4 13 9	Feb., Aug.	104	94½
80,000	5	United Elec. Tramways of Monte Video, Ord....	4/-	2/-	4½–4¾	...	...	98/9	May 19/14	6 6 6	*June*, Dec.	6⅛	4½
90,000	5	Do. do. do. 6% Cum. Pref.	3/-	3/-	4⅝–5⅛	...	...	4 13/16	June 19	5 14 3	June, Dec.	6⅜	4 7/16
500,000£	Stk.	Winnipeg Elec. Rly. Co. 4½% Perp. Cons. Debs.	4½%	4½%	87–90	...	— 2	89	May 5	5 0 0	Apr., Oct.	109½	87
40,977	5	Yorkshire (West Riding) Elec. Trys. Ord. ...	...	...	⅛–⅜	...	— 1/16	7/–	Mar. 29	...	*Mar.*	1½	⅜
46,261	5	Do. do. do. 6% Cum. Pref.	2/6	3/-	4⅜–4⅝	...	...	89/4½	May 3	6 9 9	*Mar.*	4⅝	1⅜

ELECTRIC RAILWAY STOCKS.

1,854,720£	Stk.	Central London Ord. Stock (4% Guar.)	4	4	77–78	+ 1½	...	78	May 4	5 2 9	*Feb.*, Aug.	89½	59⅜
572,640£	Stk.	Do 4% Guar. Pref. Stock	4	4	77–79	+ 1	...	79⅜	April 30	5 1 3	Feb., Aug.	92	74½
572,640£	Stk.	Do. Deferred Stock (4% Guar.) ...	4	4	75–77	+ 2	...	76½	April 20	5 4 0	Feb., Aug.	91⅜	42
50,000	10	Liverpool Overhead Ord.	2/6	3/6	4⅛–4¼	...	...	4¼	May 3	7 1 3	*Feb.*, Aug.	4⅜	⅜
1,412,263£	Stk.	Mersey Cons. Ord. Stock	Nil	Nil	3¼–3¾	...	...	2¾	Mar. 18	...	*Feb.*, Aug.	8	1
5,732,062£	Stk.	Metropolitan Cons.	1⅜	1⅜	29½–30½	+ 1	...	30	May 5	4 2 0	*Feb.*, Aug.	75⅜	28⅜
2,640,914£	Stk.	Do. Surplus Lands Stock	2⅜	2⅜	55–57	...	— 2½	55¾	May 4	4 16 6	*Feb.*, Aug.	72	54 1/16
3,235,000£	Stk.	Metropolitan District Ord.	Nil	Nil	16–18	...	— 1	17	May 5	...	*Feb.*, Aug.	51½	9⅛
500,000	10	Underground Electric Railways Co. of London	...	...	1⅜–1⅝	...	— ⅛	35/–	May 5	...	...	5 3/16	1⅜
1,730,000£	...	Do. 4½% Bonds of 1933	4½%	4½%	101–104	+ 2	...	101½	May 5	4 6 9	Jan., July	104	73
1,192,707£	...	Do. 6% 1st Income Debs.	6%	6%	112–114	+ 3	...	113⅜	April 27	5 5 3	Mar., Sept.	118	108
6,120,750£	Stk.	Do. 6% Income Bonds	60/-	60/-	80–82	...	...	80⅜	May 5	7 6 6	Mar., Sept.	97¼	18
1,150,477	1/-	Do. "A" Ord.	...	...	⅛–5/16	...	...	5/6	April 30	...	...	17/6	3/9

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estimate is £267,040. Salaries and wages of administrative staff, rent, rates, compensation, etc., absorbed £85,629; the new estimate is £84,085. On capital account the committee effect a saving of £54,100, the estimated expenditure being £31,100, as against payments in 1914-15 of £85,220 and an estimate of £160,000. A big reduction is shown in renewals and depreciation fund, the estimate being £7,643, against last year's expenditure of £48,933 and a previous estimate of £102,852. Since the outbreak of the war to March 31, £31,647 has been paid to dependents of men with the colours, but the expenditure for the new financial year under this head is £58,000.

LEEDS CITY TRAMWAYS

The annual statement of income and expenditure of Leeds Corporation Tramways was submitted to a meeting of the Tramways Committee held on Monday, April 19, by Mr. J. B. Hamilton, general manager. The figures show that in spite of the war the financial year ending on March 31 was highly successful, and £81,567 is to be handed over to relief of rates. The total income for the year amounted to £433,940, which is an increase of £6,485 over the receipts in the previous year. Deducting £115,601 for traffic expenses, £40,347 for general expenses, £43,010 for general repairs, and £28,577 for power expenses—a total of £228,134—a gross surplus is left to carry forward to the net revenue account of £205,805, which compares with £201,073 for the year ended March 31, 1914. After adding bank interest and dividends on redemption fund investments, and deducting charges for interest on capital, income tax, etc., a balance is left to carry forward to the appropriation account of £151,526. There falls to be deducted from this balance £57,777 for contributions towards the repayment of capital, which is equivalent to depreciation. After deducting further amounts provided for permanent way and electrical renewals, a free net surplus is left to carry forward to the relief of rates of £81,567. Last year's figure was £70,004, and £81,567 is quite the biggest sum ever put aside for this purpose, being equal to a rate of 9d. in the pound.

Between 800 and 900 men from the department are now serving their country either in the services or upon Government work, and since the beginning of the war £4,460 has been paid by the committee in allowances to dependents. At the end of last July there was an increase in the receipts of £7,000, but the figures were naturally affected by the outbreak of war soon afterwards. The increased income tax also meant the expenditure of some £2,000 not foreseen. Generally speaking, however, the expenses of the department are lower, reckoned on the basis of the cost per car-mile. In the previous year the average expense per mile was 2·96d.; last year it was 2·91d. The general and power expenses have both decreased, while the cost of power production shows a slight rise. The total amount of working expenses in 1913-14 came out at 5·90d. per car-mile; last year they were 5·74d. per car-mile, a reduction which, in consideration of the all-round increase in the prices of materials, is very gratifying. The accounts were approved by the committee, who considered them very satisfactory, and complimented the general manager and staff.

BELFAST CORPORATION TRAMWAYS.

Mr. Andrew Nance, general manager of Belfast City Tramways, has presented to the Tramways and Electricity Committee his report on the general working of the tramway undertaking for the year ended March 31, 1915. In this he says that the total revenue amounts to £270,237, and the working expenses to £156,379. This leaves a trading profit of £113,858 for the year. The net revenue charges, including interest on debt (which is equal to a dividend of 3½ per cent. upon the entire capital expended), the annual fixed payment of £8,962 to the general purposes fund, income tax, stamp duty, etc., amount to £61,825. The net revenue (or disposable profit) therefore amounts to £52,034. The trading profit of £113,858 compares with £111,784 for the preceding year, an increase of £2,074. The net profit of £52,034 compares with £51,258 for the preceding year, an increase of £776.

The declaration of war in the first days of August affected the receipts of the tramway undertakings in the cities and large towns of Great Britain to a most alarming extent. The Belfast undertaking lost about £21,600 in receipts between August 1, 1914, and the end of the financial year.

The disaster to the receipts was met, to some extent, by a careful adjustment of the services to traffic needs, which, with the reduction made in permanent way repairs by the city surveyor's department, reduced the working expenses by over £12,000 for the eight months affected. The result is that there is a balance at the disposal of the general purposes fund of £3,757, in addition to the £8,962 already paid. This balance would have been £6,815 but for the charge of £3,058 for war pay to the dependents of the 156 of the staff who have left to fight for their country's cause on the continent. Thus, in spite of the loss of £21,600 in receipts, the payment of £3,058 for war pay, and the extra charges for rates and taxes and insurance, amounting to £3,364, the tramways have earned an increased working profit, an increased net profit, and an increased surplus.

The Chairman of the Finance Committee was told on February 23, 1914, that "provided reasonably normal circumstances prevailed," the Tramways Committee anticipated that the tramway undertaking would be in a position to contribute £10,000 to the relief of rates out of the profits of the year ending March 31, 1915. No one will suggest that the circumstances of the last eight months of the past year have been "reasonably normal." Mr. Nance submits therefore that the fact that they have so managed to work the undertaking as to earn a surplus of £3,757 is a satisfactory outcome of very difficult circumstances.

With regard to the actual disposal of the net profit of £52,034, this is strictly defined by the Aberdeen olause of the Belfast Tramways Act, 1904:—

	£	s.	d.
Sinking fund	31,276	11	7
Depreciation fund	17,000	0	0
General purposes fund	3,757	4	9

The buildings, depots, cars, and machinery have been maintained in efficiency, perfect order, and good repair. The stock of cars now numbers 291. All these have top covers except seven, which are equipped during the winter as snow ploughs.

CONTRACTS AND ORDERS.

Messrs. Rowlands and Company have an order from Lowestoft Corporation for one dozen gear wheels at £3 6s. each.

Prahran-Malvern (Victoria) Tramways Trust have accepted the tender of Elder, Smith and Company for a Tudor buffer battery.

Messrs. A. L. Gibson and Company have an order from Glasgow Tramways Committee for roller shutters for the Langside shelter.

Prahran and Malvern Tramway Trust, Victoria, have placed an order with Noyes Pty., Limited, for a booster and switch gear at £920.

Messrs. Chamberlain and Hookham have been awarded the contract for a year's supply of tramcar meters for Manchester Corporation Tramways.

Croydon Corporation have accepted the tender of Messrs. E. Green and Son for a new economiser with 384 tubes and damper gear for the electricity works.

The British Thomson-Houston Company have an order from Glasgow Corporation Tramways Committee for switch gear for Kinning Park sub-station.

Messrs. Mossay and Company have an order from the Wolverhampton Electricity Committee for a 2½-ton Orwell electric vehicle and equipment at £630.

E. Bennis and Company, Limited, have an order for two stokers and self-cleaning compressed air furnaces from the electricity department of Burton-on-Trent.

The British Niclausse Boiler Company's tender for two water-tube boilers at £8,400 has been accepted by the Rotherham Electric Light and Tramways Committee.

The British Westinghouse Company, Limited, have arranged a contract with the Melbourne City Council for a 5,000-KW. turbo-alternator at £15,111, and spare parts, £1,015.

Liverpool Electricity Committee have accepted tenders from Babcock and Wilcox, Limited, for three water tube boilers, coal and ash handling plant, etc., and from E. Green and Sons, Limited, for three economisers and accessories.

The Underfeed Stoker Company, Limited, have recently received orders from Lisbon Electric Tramways, Derbyshire and Nottinghamshire Electric Power Company, Blackpool Corporation, and Leigh Electricity Department.

Huddersfield Tramways Committee have accepted the tender of Messrs. J. Brown and Company for steel tramcar tires, and for brake blocks and castings from Messrs. France and Brook, Slaithwaite, and Melton and Company.

Siemens Brothers Dynamo Works, Limited, have secured the contract for the annual supply to the Croydon Corporation Tramways, and the Salford Corporation Tramways Department of Wotan, Tantalum, and carbon filament lamps.

Messrs. Vickers, Limited, are supplying from their Sheffield works two large turbo-alternators of 5,000-KW. capacity each for the Philadelphia power-station, near Sunderland, the contract for which was originally given to the A.E.G. of Berlin.

Wolverhampton Town Council have agreed to the recommendation of the Electricity Committee to purchase an electric vehicle for removing ashes from the Commercial Road generating-station. The price of the machine is to be about £630.

Messrs. E. Bennis and Company have received an order from the London County Council for a complete equipment of stoker links for experiment with different types of coal in the furnaces at the Greenwich generating-station at a cost not exceeding £160.

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J. W. and T. Connolly, Limited, who have a contract for retiring van and cart wheels for the London County Council's tramways department, have been granted an increase over the present prices of 15 per cent. for new tires and 5 per cent. for contracting old tires.

Croydon Borough Council have accepted the tender of Callender's Cable and Construction Company, Limited, for the supply of electric cables for the year to March 31, 1916. This is subject to a clause providing for payment on a sliding scale based upon the price of copper, which was reported to be about £70 per ton.

The Ailsa Oilskin and Rubber Company state that they are now in a position to contract for motormen's oilskins or to repair or re-oil oilskin coats, etc. A few months ago, when the company were fully occupied with special contract work, it was impossible for them to accept work of this kind, when prompt delivery was demanded.

Port Elizabeth (S.A.) Corporation have made the following contracts :—1,000-KW. turbo-alternator (turbo, Fraser and Chalmers, Limited; alternator, Dick, Kerr), 6,600 volts, three-phase, 50 periods; switchboard, British Thomson-Houston Company, Limited; motor converters, Bruce Peebles and Company, Limited; marine type water-tube boilers and coal conveyor and bunkers, Babcock and Wilcox, Limited.

The Railway Track Supply Company (of Great Britain), London, inform us that they have just received a further order from the Great Western Railway for Elwell-Parker electric trucks. This is the sixth order received from the same railway, which will have 17 of these trucks in use when the present order has been executed. We understand that the Elwell-Parker trucks in use at Euston by the L. and N.W. Railway are doing good work. Five of the largest English railways have now placed orders for Elwell-Parker motor trucks.

London County Council Tramways Annual Supplies.—The Highways Committee have accepted the following tenders for the supply, during 1915-16, of tramway equipment :—

Electrical equipment (motor generator) spares.—British Westinghouse Electric and Manufacturing Company, Limited; Dick, Kerr and Company, Limited; A. Clare and Company (£513 8s. 6d.); Manchester Armature Repair Company (£201 5s.).

Electrical equipment (controller, circuit breaker and other switch, etc., details, and magnetic brake) spares.—British Westinghouse Electric and Manufacturing Company, Limited; Dick, Kerr and Company, Limited (£38 14s.).

Contact fingers and parts, segments, etc.—British Westinghouse Electric and Manufacturing Company, Limited (£61 4s. 3d.); Dick, Kerr and Company, Limited (£6); Dyer and Young (£188 0s. 9d.); E. Showell and Sons, Limited (£122 8s.); Tramway Supplies (£1,194 17s. 6d.).

Pressed brass and steel articles.—M. Mole and Son (£684 7s.); Hadfield's, Limited (£69 10s. 1d.); Peter Hooker Limited (£19 17s. 6d.).

Electric cable, fuse wire, and cotton-covered copper wire.—British Insulated and Helsby Cables, Limited (£820 16s.); Hooper's Telegraph and India Rubber Works, Limited (£400); Liverpool Electric Cable Company, Limited (£410 8s.); Midland Electric Wire Company (£53 1s. 8d.); Saxonia Electrical Wire Company (£120).

Copper bond.—British Insulated and Helsby Cables (£1,033 10s.).

Rubber details.—J. G. Ingram and Son (£2,144 0s. 2d.); Irwell and Eastern Rubber Company, Limited (£61 7s. 8d.); North British Rubber Company, Limited (£46 7s. 8d.) F. Reddaway and Company, Limited (£33 6s. 6d.).

Moulded insulators (other than rubber).—British Westinghouse Electric and Manufacturing Company, Limited (£87 11s. 8d.); Crystalate Manufacturing Company, Limited (£12); Ebonestos Manufacturing Company, Limited, Litholite, Limited (£308 19s.).

Fibre articles.—J. Burns, Limited (£22 11s. 4d.); Spauldings, Limited (£11 9s.); A Cort and Company (£6 10s. 6d.).

Mica and micanite articles.—G. Schultz and Company (£4 6s.).

Track Insulators.—Bullers, Limited (£4,462 10s.); Gaskell and Grocott (£201 13s. 4d. Douiton and Company, Limited (£103 2s. 6d.); Taylor, Tunnicliff and Company (£103 2s. 6d.).

Car furniture.—J. M. Siddell (£132 6s. 9d.); E. Showell and Sons (£93 14s. 7d.); G. D. Peters and Company, Limited (£13 17s. 2d.); Brush Electrical Engineering Company, Limited (£79 4s.); Gabriel and Company (£32 8s.).

Machined bronze bearings.—The Anti-Attrition Metal Company, Limited (£3,924 6s.).

Machined finished articles (brass, gun-metal, etc.).—E. Showell and Sons, Limited, (£161 2s. 11d.); allowance for worn-out bushes, 6d.; Gabriel and Company (£7 14s. 6d.) Anti-Attrition Metal Company, Limited (£180 18s.); Brecknell, Munro and Rogers Limited (£292 10s.).

Machine finished articles (wrought iron and mild steel).—Bayliss, Jones and Bayliss, Limited (£682 18s. 3d.); British Westinghouse Electric and Manufacturing Company, Limited (£103 15s.); F. W. Cotterill, Limited (£39 14s.); J. Holroyd and Company, Limited (£133 10s.); Ibbotson Brothers and Company, Limited (£170 15s. 6d.); C. Richards and Sons (£54 2s.); W. J. Ritchie and Company (£70 19s. 4d.); F. W. Rowlands (£16 4s.); Wilkes, Limited (£123 7s.).

Gear and pinion wheels, ratchets, worms, etc.—F. W. Rowlands and Company (£1,255 16s.); J. Holroyd and Company, Limited (£36).

Drop forged stampings.—British Westinghouse Electric and Manufacturing Company, Limited (£51 5s.).

Iron and steel forgings. Bayliss, Jones and Bayliss, Limited (£182 12s.); Brush Electrical Engineering Company, Limited (£69 12s.); East Ferry Road Engineering Works Company, Limited (£21 18s.); Male and Jordan (£204 2s. 4d.); W. J. Ritchie and Company (£79 4s.); Warren and Sons (£15 12s.); Hadfield's, Limited (£47 16s.).

Springs. The Crown Spring Company (£134 9s. 8d.); West Bromwich Spring Company, Limited (£520 1s. 6d.); Joseph Steel and Sons (£14 17s.).

Machined iron castings.—Carron Company (£1,501 15s.); A. Clare and Company (£19 10s.); J. Holroyd and Company (£137 10s.); H. Newton Knights and Company (£360); T. Summerson and Son, Limited (£585).

Brake shoes.—Pease and Partners, Limited (£3,416 17s. 6d.).

Machined malleable iron castings.—Bullers, Limited (£753 19s.); Leys Malleable Castings Company, Limited (£448 19s.); Brecknell, Munro and Rogers, Limited (£36.)

Malleable iron castings.—Bullers, Limited.

Steel castings.—Hadfield's, Limited (£539 17s. 6d.); M. and G. Truck and Engineering Company, Limited (£200 17s.); E. Allen and Company (£264 17s. 6d.); S. Peace and Sons, Limited.; H. R. Marsden, Limited (£22 1s.).

Foundry crucibles.—Morgan Crucible Company, Limited (£296 10s. 7d.).

PERSONAL.

Mr. T. P. Frank, of Newark, has been appointed borough surveyor of Stockton.

Mr. J. T. Ellison has been appointed chief inspector to the Darwen Corporation Tramways.

Mr. W. Stubbs, borough engineer of Blackburn, has resigned after having held the position for nineteen years.

Mr. W. H. Robins has been appointed engineer and manager, and Mr. W. M. Valon secretary, of the Stafford electricity works.

Mr. W. Thompson, deputy borough engineer and surveyor of Burton-on-Trent, has been appointed borough surveyor of Mansfield.

Mr. T. C. Winfield has been appointed works superintendent of the West Ham Corporation Tramways. There were 127 applicants for the position.

Capt. Fred Coutts, 5th Territorial Battalion, Black Watch, and general manager, Paisley District Tramway Company, has been promoted major.

Mr. F. Young, electrician of the Dover Corporation Tramways, who recently resigned, has been presented by his colleagues with a silver rose bowl.

Mr. J. S. Badger has been appointed managing director of the Brisbane Tramways Company. He is succeeded as manager by Mr. J. W. Gillette.

Mr. Harold Dickenson, electrical engineer to Liverpool Corporation Tramways, has been elected to the Council of the Electrical Engineers' Association.

Mr. Frederick Taylor, car shed superintendent at Bolton, has resigned, and applications are being invited for the vacancy, the salary offered being £200 per annum.

Mr. Max Muspratt has been congratulated by his colleagues on the Liverpool Tramways Committee on his appointment as Government Supervisor of explosive materials.

Mr. V. F. Bush, formerly assistant mains engineer of West Ham Electricity Department, has been appointed assistant engineer of Redditch Urban District Council Electricity Works.

Mr. J. W. Dugdale, tramways manager of Oldham, has now, we are pleased to learn, so far recovered from his recent illness that he was able, although against his doctor's advice, to attend an important committee meeting.

Mr. J. P. Tierney has been appointed consulting electrical engineer to the Kingstown Council, and has been instructed to prepare plans for an electric supply for the district and to supervise the carrying out of the work.

Mr. E. Russell-Taylor, chairman of the Liverpool Corporation Electricity and Tramways Committee, was congratulated by his colleagues at a meeting of the committee held on April 10 on the celebration of his silver wedding.

Mr. J. H. Rider read a paper at the Institute of Electrical Engineers recently on "The Power Supply of the Central Mining-Rand Mines Group." The paper was read on the same night at the Manchester and Birmingham sections.

Bristol Tramways Purchase.—Mr. H. Faraday Proctor, the city electrical engineer, has been nominated by Sir John Snell to take part in the joint valuation of the sections of the Bristol Tramways which are purchasable by the Corporation.

Mr. J. J. M'Mahon, electrical engineer in the overhead department of Manchester Corporation Tramways, was on his way to spend a holiday in the Canary Islands on board the *Aguila*, when she was torpedoed by a German submarine. He was picked up in the open sea by the steamship *Lady Plymouth*.

Mr. F. W. Bricknell, Assoc.M.Inst.C.E., has been appointed city engineer of Hull at a salary of £750 per annum. The appointment involves no alteration in regard to the tramway work, but the Tramways Committee has reserved the right to make new arrangements if they think fit on completion of their workshops.

Mr. J. C. Williams, chief assistant and deputy engineer of the Rotherham Corporation Tramways and Electric Light Department, who was recently appointed electrical engineer and tramways manager at Erith, has been presented by the staff and employees with a gold watch, and by the Executive Committee of the Rotherham Municipal Officers' Guild with a set of solid silver entree dishes.

Mr. Edward Ellis. of Leeds, who has been Yorkshire District Engineer for the Great Northern Railway Company for twenty-five years, has retired from the service on reaching the age limit. Mr. Ellis took an important part in the constructional developments of the line which have taken place during his long period of service, and retires with the thanks and appreciation of the directors of the company and the men who have worked with him.

Mr. William Stitt, general passenger agent of the Eastern lines of the Canadian Pacific Railway, died suddenly on April 1, while at work in his office in Montreal. A native of Kirkcudbright, Scotland, he joined the serivce of the Canadian Pacific Railway in

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1888, holding various positions with credit, and latterly joining the head office in Montreal. Mr. Stitt was a man of fine natural humour, and one of the best-known railway officials in Canada.

Mr. W. T. Robson, manager of the South Shields Corporation Tramways, has been appointed manager of the Southampton Corporation Tramways at a salary of £400 a year. He was one of several candidates interviewed by Alderman Dunsford, Councillor McDonnell, and the Town Clerk. Mr. Robson was the choice of the deputation, and he was subsequently interviewed by the Tramway Committee, who recommended his appointment.

A Dover Appointment.—The Tramways Committee of Dover Corporation invited to an interview the following candidates for the position of depot foreman and electrician:—Mr. Palmer, deputy depot superintendent of Blackburn Corporation Tramways; Mr. Bond, works superintendent of Colchester Corporation Tramways; Mr. Carley, depot foreman of West Riding Tramways, Yorkshire; Mr. Pink, G.P.O. engineering staff, Dover. At a subsequent meeting the committee appointed Mr. Bond to the position.

Mr. T. W. Watts, at present goods manager for the Ipswich District of the Great Eastern Railway, has been appointed commercial superintendent to the company. Under the supervision of Mr. W. C. May, chief traffic manager, he will deal with all commercial matters relating to the company's traffic, both goods and passenger, including season tickets. The office will be at Liverpool Street Station, and all communications should be addressed to him there. Mr. P. Syder has been appointed to succeed Mr. Watts as district goods manager for the Ipswich District. Mr. Watts and Mr. Syder commenced their new duties on April 12.

Mr. George Macaulay Booth, whose recent appointment to the Armaments Committee has aroused much interest, is a man with wide business connections. The son of the Right Hon. Charles Booth, and cousin of Mr. A. A. Booth, chairman of the Cunard Company, he is a partner in the firm of Alfred Booth and Co., a director of the Booth Steamship Company, vice-chairman of Manaos Harbour, Limited, and a director of the Manaos Tramways and Light Company. Mr. Booth repudiates the idea that he is the man whom Mr. Lloyd George had in mind when the Chancellor spoke of calling in the services of a man of "push and go."

Mr. J. P. Thomas has been presented with a gold watch and chain by the inspectors, stationmasters, and clerical staff of the tube railways as an expression of their esteem and good wishes on his relinquishing the position of superintendent of the London Electric, the Central London, and the City and South London Railways. Mr. W. E. Blake, who has succeeded Mr. Thomas as superintendent of the tube railways, made the presentation. It will be recalled that among the recent changes in the Underground official staff we noted in a former issue was the appointment of Mr. Thomas as general superintendent of the London General Omnibus Company.

Mr. Marten Turner has been appointed general manager of the North Ormesby, South Bank, Normanby and Grangetown Railless Traction Company. Until the completion of the new offices of the company, Mr. Turner's address will be care of Mr. W. P. Ingham, Royal Exchange, Middlesbrough. Mr. Turner was for some years with the Colne and Trawden Light Railway Company, and up to the time of the transfer of that undertaking to the Colne Corporation and the winding up of the Company. The railless traction system at North Ormesby is now under construction, and it is expected that the lines will be ready for working during the present year.

Mr. James Bird, who has just been appointed Clerk of the London County Council, has been deputy clerk since 1905. Mr. Bird, who is 52 years of age, has been in the service of the Council and its predecessors since 1881, when he was appointed a member of the staff, after competitive examination. The General Purposes Committee of the London County Council, in recommending Mr. Bird's appointment as Clerk to the Council, said that during Sir Laurence Gomme's absence through illness in 1913, Mr. Bird performed the duties of Clerk of the Council in a completely satisfactory manner, and they had no hesitation in saying that his promotion would be in the best interests of the Council.

Funeral of Mr. H. G. Doggett.—A large congregation assembled at St. Mary's, Leigh Woods, on Thursday, April 15, on the occasion of the funeral of Mr. H. G. Doggett, a director of Bristol Tramways and Carriage Company, whose death took place at Falmouth, on Sunday, April 11. Sir George and Lady White were among the chief mourners and friends of the deceased, and the Bristol Tramways and Carriage Company was officially represented by the following:—Mr. J. H. Howell and Mr. Samuel White (directors), Mr. H. F. Cooper (secretary), Mr. H. White Smith (accountant), Mr. Chas. Challenger (manager), Mr. W. H. Munton (electrical engineer), Mr. R. W. Mercer (registrar), Mr. G. T. C. Edwards (resident engineer), Mr. W. J. Green (branch manager, Weston-super-Mare), Mr. A. B. Bryant (branch manager, Bath), Mr. J. D. Howell (branch manager, Cheltenham), Mr. H. J. Balchin (branch manager, Gloucester), and others. The other companies and institutions with which Mr. Doggett was associated were also represented.

TRAMWAY AND LIGHT RAILWAY NOTES.

ABERDEEN.

Free Passes.

The Tramways Committee of Aberdeen Town Council, at a meeting held on April 26, agreed to continue the system of giving free tokens for travel on the tramcars to soldiers, sailors, and military nurses. The committee also resolved to grant a donation of three guineas to the Tramway Male Voice Choir, and to allow collectors to dispose of flags on the cars during Polish Flag Day, the event being advertised free on the cars.

AIRDRIE.

Reduction of Tramway Assessment.

Airdrie and Coatbridge Tramways Company, considering that the deduction of 36 per cent. on the valuation of their property for assessment purposes was much too small, intimated to Old Monklands Parish Council, the assessing authority, that they had decided to refer the matter to a judicial tribunal. The Chairman's Committee of the Council reported that having considered the whole circumstances and made comparison with other undertakings, they agreed to recommend that a further deduction of 9 per cent. be offered to the Tramway Company, making a deduction of 45 per cent., instead of 36 per cent. as previously offered. This was agreed to.

BIRMINGHAM.

Service to be Curtailed.

The earlier closing of the licensed houses in Birmingham has resulted in a considerable diminution in the late traffic, and the Tramways Department have come to the conclusion that it is no longer necessary to run the Corporation cars as late as usual. Mr. A. Baker (the general manager) presented a report on the subject to the Tramways Committee of the City Council at their meeting on April 19, in which he advised that a reduction might now without inconvenience or difficulty be made in the late service of cars all through the municipality after half-past ten. After due consideration the committee decided that after half-past ten fewer cars should be run on all routes, and that the last cars should leave the city termini at half-past eleven.

BRADFORD.

Maintenance of Railless Trolley Routes.

Some time ago Bradford City Council appointed a sub-committee consisting of members representing the Streets, Drainage and Works, and Tramways Committees, to deal with questions arising from the wear of roads on railless trolley vehicle routes. It is reported that the sub-committee has decided to recommend to the City Council that some annual contribution, on a basis to be determined later, should be made by the Tramways Committee to the funds of the Streets and Drainage and Works Committees, without prejudice to the position of either bodies concerned, in respect of the extra expenditure found to be necessary for the maintenance of roads on railless trolley vehicle routes in the city.

EDINBURGH.

Cars for Edinburgh.

The Tramway Committee of Edinburgh Town Council met on March 31 to consider the report of the burgh engineer on the tramway service. The report stated that there were 64 top-seated cars out of 200 in the tramway service, and that increase of the number of top-seated cars was restricted by the low roofing of the existing tramcar sheds. It was also pointed out that the power at present at command of the Tramway Company was unequal to the strain of carrying a very large additional number of heavy cars. The burgh engineer concluded, however, that from 20 to 25 top-seated cars could be added with very little difficulty. The committee agreed to recommend to the company that 25 additional top-seated cars should be put on the tramway routes.

Experiment with Self-Propelled Cars.

At a meeting held on March 31, the Tramway Committee of Edinburgh Corporation agreed to a report by a sub-committee recommending that an experiment be made with self-propelled cars in the city, and remitted the matter to the sub-committee to take such steps as they think proper. As there are no available cars in the country, a new car will have to be built for the experiment.

COVENTRY.

Return Tickets at Reduced Fares.

With a view to meeting the needs of persons of limited means, who do not come within the class of workmen as defined by the Tramways Acts, Coventry Tramways Committee have recommended the adoption of return tickets issued at reduced fares.

DONCASTER.

Free Rides for Councillors.

At the meeting of Doncaster Town Council held on April 7, the minutes of the Council Committee meeting, at which they granted

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themselves free rides on the Corporation tramways, came up for consideration. The minutes stated that Councillor Jackson, seconded by Alderman Spencer, proposed the following motion :—" That the Council, realising the continually increasing demand on the time of its members, and the distance many of them have to come in order to attend the many committee meetings, hereby decides to instruct the electrical engineer to provide and supply each member of the Council with a special coupon, so that they have the right to ride free on any route of the Council's tramways, and that the sum of £50 be paid to the Tramway Committee out of the borough fund for carrying into effect the Council's decision." Objection was taken that the second part of the motion was out of order, and that part was therefore withdrawn. The first part was carried by 21 votes to 11 against. At a subsequent meeting of the committee the matter was reconsidered, and a motion was moved by Alderman Theobald that the resolution be amended by the addition of the words " when engaged solely on the business of the Council." Alderman Spencer now moved the adoption of the minutes of the Council in committee, which included these minutes. An amendment was moved and seconded on the ground that the proposal was contrary to the spirit of the Municipal Act, but the grant of free rides was carried by a majority of 19 to 16.

DUNDEE.

Tramway Arbitration.

The first stage in the arbitration proceedings between Dundee Corporation and Dundee, Broughty Ferry and District Tramways Company has been concluded. The question at issue is the amount to be paid for a portion of the company's tramway within the city boundary, which the Corporation has power to take over, Dundee Town Council regarding the company's claim of £14,500 as excessive. Mr. Stephen Sellon, consulting engineer, Westminster ; Mr. George Balfour, managing director of the company ; and Mr. J. J. Maclaren, surveyor, Dundee, gave evidence in favour of the company. A settlement has been effected on the price to be paid for overhead equipment, the company accepting £640 in lieu of their claim for £985. The inquiry was adjourned until Friday, May 7.

HUDDERSFIELD.

Dealing with Tramway Free Passes.

The Town Council have passed the following resolution :—" That the Tramways Committee be recommended to provide for no one being allowed to travel on a tramcar without giving up to the conductor on each journey a token representing his fare. That the Tramways Committee be recommended to see that free passes are only used by employees whilst travelling on Corporation business, and not when travelling to and from home."

ILFORD.

Result of Rejecting Manager's Advice.

The Council, after a long debate on the financial condition of the tramway undertaking, have instructed the Tramways Committee to consider the advisability of obtaining expert advice to assist the Council in formulating a scheme by which the undertaking can be placed upon a sound commercial basis. Councillor Bailey said that the Council had not accepted the manager's advice, and was apparently taking upon itself the responsibility. If the sum of £2,500 had not been paid out of reserve in the relief of rates some years ago, the reserve would have been quite £10,000.

LEICESTER.

Fined for Obstructing a Tramcar.

At Leicester Borough Police Court, on April 20, William Kenyon, a Nottingham carman, was fined 20s. for wilfully obstructing a tramcar, so that it arrived at the terminus four minutes late. It was shown in evidence that there was plenty of room for the defendant to keep clear of the tramway track.

MUSSELBURGH.

Maintenance of Track.

The Town Council proposes to require the Electric Tramway Company to improve its track. The burgh surveyor has reported that the track between Loretto and Levenhall is in a state of serious disrepair.

NEWPORT.

Effect of High Price of Coal.

The Electricity and Tramways Committee of Newport (Mon.) Corporation have received a report drawn up by Mr. Young, general manager, and Mr. A. Nichols Moore, electrical engineer, on the costs of electricity. The report states that, since the presentation of the estimates for 1915-16, based on a cost of 12s. per ton for coal, the price of the latter commodity has risen to about 20s. per ton. This increased cost, together with other rises in prices and costs caused by the war, is estimated to result in a deficit for the coming year amounting to over £7,000. To reduce the loss it is proposed that the charges for electricity be increased by 20 per cent. The Committee recommended that the report be adopted.

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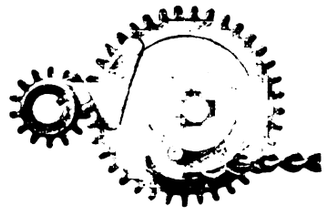
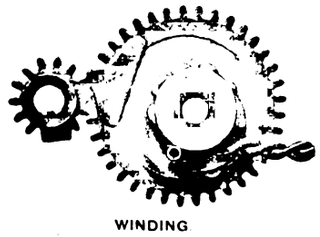
and by preventing the drum from over-running on release, save three-quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



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NEWCASTLE.

OPENING OF EXTENSION.

The formal opening of the extension of Newcastle Corporation tramways from Newburn to Throckley took place on Thursday, April 22. On arrival at Throckley, the civic representatives of Newcastle, the members of the Newburn Urban District Council and others taking part in the opening ceremony were entertained to tea by the Tramways Committee of the Corporation. Alderman J. H. Rodgers, Chairman of the Tramways Committee, presided, and was supported by the Lord Mayor (Alderman Fitzgerald), the Lady Mayoress (Miss Fitzgerald), and others. Councillor Richard Mayne, Chairman of the Extension Sub-Committee, gave a short sketch of the history of the extension, and stated that the work would have been completed sooner but for the war. He ventured to say that there was no tramway in England which had presented so many engineering difficulties as the Newburn route, and he congratulated Mr. Steele, the City Engineer, upon the successful way in which those difficulties had been overcome. Mr. Mayne was presented with silver mementoes of the occasion, and compliments were paid to Mr. E. Hatton, general manager of the tramways, to Mr. Steele, city engineer, to the town clerk, Mr. A. M. Oliver, and to Mr. J. H. Rodgers, chairman of the Tramways Committee.

NOTTINGHAM.

TROLLEY POLE BREAKS OVERHEAD WIRE.

Four sections of the Nottingham tramway service were stopped by a singular mishap on Friday, April 23. The trolley pole on a car became wedged in the fittings of an overhead wire at a sharp turning near the junction of two streets, and broke the wire. Two cars were damaged, the trolley poles of both leaving the wires. No one was injured.

OLDHAM.

BAD COAL AT OLDHAM.

The deficient supply of coal at high prices is hitting tramway enterprise in various ways. Oldham tramway manager reported to the committee that during the past two weeks they had been getting a very poor supply of electricity, and that they had to withdraw the service for two hours on one day. He attributed the failure to the poor quality of coal they had been compelled to use.

PLYMOUTH.

PROBABLE PURCHASE OF DEVONPORT TRAMWAY.

It is reported that Plymouth Corporation have offered to purchase the Devonport tramways from the British Electric Traction Company, and that negotiations as to price are still proceeding.

SALFORD.

WORKMEN'S RETURN TICKETS WITHDRAWN.

Salford Tramways Department have withdrawn the daily workmen's return tickets granted as a special concession about twelve months ago. By the return tickets a small saving on the ordinary workmen's tickets was effected. The issue of the ordinary workmen's tickets will be continued.

STIRLING.

SUCCESSFUL TRIALS OF SELF-PROPELLED CARS.

The Stirling and Bridge of Allan Tramways Company, the only horse-drawn system now in Scotland, have been experimenting for some time with a self-propelled petrol car on the route between Stirling and St. Ninians. The trials have proved so successful that the Company have now intimated to the road authorities their intention of applying for a Provisional Order to obtain powers for the substitution of petrol cars for the horse-drawn vehicles.

SWANSEA.

TRAMWAY WORK POSTPONED.

The Swansea General Purposes Committee have decided to recommend to the Council that the powers in its Light Railways Order for the construction of a tramway up Mount Pleasant be not exercised till the Local Government Board is in a position to allow the scheme for the erection of houses for the working classes on Town Hill to proceed, and, if necessary, that an application be made to the Light Railway Commissioners for an extension of time for the purchase of land and completion of works in connection with the order.

WEST HAM.

A LOW RAIL COSTS £50 IN DAMAGES.

On Thursday, March 25, a case of considerable importance to tramway authorities was tried at Bow County Court, before Judge Smyly and a jury. The case was that of William Coates, a carman, who sued West Ham Corporation for damages in respect of injuries sustained by him in an accident. Coates was leading his horse, attached to a tip cart, off the tram track, when the wheel of the cart skidded, causing the horse to stumble and knocking the carman down. The wheel of the vehicle passed over Coates, and he was taken to West Ham Hospital suffering from compound fracture of the left ankle and a broken arm. According to the plaintiff, West Ham Corporation was to be held responsible for the accident, it being alleged that the skidding of the cart was caused by the tram-rail being below the level of the granite setts. Both sides agreed that the tram-rail was seven-tenths of an inch below the level of the granite setts. Counsel for the plaintiff pointed out that the Act of Parliament laid it down that "the surface of the rail shall be on the level of the surface of the road." For the defence it was contended that the custom was to lay the rail slightly under the level, because wood pavement or granite setts wore down more quickly than the metal of the rail. His Honour, however, told the jury that they must apply the Act of Parliament as read by sensible men. It was difficult to say how the universal custom was according to the Act. The jury must not think that the road could be maintained as level as a billiard table, but as level as could be maintained with reference to the use of the road. They must determine if the rail was being maintained in a reasonable way. The jury answered the question in the negative, and said the road was out of repair. They also found that the condition of the road led to the accident, and awarded the plaintiff £50.

YORK.

EFFECT OF TREASURY RESTRICTIONS.

The requirement of the Local Government Board that capital expenditure by local authorities should be restricted, and that works now in course of construction should be suspended, has placed York Tramways and Electricity Committee in a serious difficulty. The committee had commenced construction of a new tramway route when the Local Government Board's circular letter intimating Treasury restrictions was received. Large quantities of the materials for constructing the lines are on the ground, and contracts to the amount of nearly £16,000 have been placed. Stoppage of the work will involve the city in serious loss. At a meeting of the committee held on Tuesday, April 20, it was decided to appeal to the Treasury to provide funds for carrying out the works already in course of construction or about to be commenced, on the ground that if the contracts are not fulfilled a heavy financial burden will be imposed on York ratepayers.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

4,832 Wheel brakes—J. T. Westwood and J. B. Sommerville.
4,836 Resilient rubber tires—A. Tomlins and J. Hamblet.
4,883 Two-stroke petrol engine—A. J. F. Jones and B. C. Jones.
4,885 Means for connecting electrical conduits to their fittings—F. L. Broughton.
4,895 Combined electric lighting and starting apparatus for motor vehicles—L. Duca, E. Naldini, C. Massavelli, and L. Bellone.
4,911 Electro-magnetic switches—British Thomson-Houston Company, Limited (*General Electric Company*).
4,921 Resilient wheel for vehicles—B. O. Bergersen.
4,970 Railway sleepers—Coir Tire Company, Limited, and G. D. Rose.
5,027 Means for the regulation of railway traffic—H. Von Kramer.
5,076 Electric signalling systems—J. Boot and W. E. Scourfield.
5,110 Motor vehicles—G. Barker.
5,114 Appliances for holding records and giving diagrammatic representations of positions of trains together with working times, for use in train control offices on railways—E. S. Hadley.
5,145 Signalling apparatus—R. Yates and J. D. Miller.

FOR HIGH-CLASS
CONDENSING PLANT
WRITE TO
THE MIRRLEES WATSON CO., LTD.,
SCOTLAND STREET, GLASGOW.

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5,146 Apparatus for preventing the overrunning of signals on railways—H. Coates and C. E. Coates.
5,171 Top-deck seats of omnibuses—W. J. Blackwell and S. B. Cope.
5,173 Motor road vehicles—E. D. Self.
5,175 Magneto ignition for internal combustion engines of motor vehicles—J. W. T. Cadett and C. Percy.
5,188 Air-brake systems—P. Comerford and J. P. Hicks.
5,191 Train-stopping apparatus—G. E. Shultz.
5,215 Safety devices or fenders for moving vehicles—P. G. Owen.
5,309 Spring suspension system for road and railway vehicles—E. H. Owen.
5,355 Double-decked vehicles—L. Spängler.
5,368 Rail joints—O. C. Arboren.
5,369 Frames and bodies of motor vehicles—T. Hedges.
5,437 Car doors—W. E. Constable and N. T. Snodgrass.
5,619 Method of imparting forward motion to road vehicles or railway carriages—J. Allin.
5,621 Semi-pneumatic safety tires for motor vehicles—A. Tomlins and E. C. Hutton.
5,657 Trolley-setting guide for use on tramways—J. A. Walshaw.
5,678 Automatic coupling mechanism for railway vehicles—E. H. Dewson and T. R. Brown.
5,682 Couplings for rolling stock of railways and tramways—G. R. Hughes.
5,713 Side guard for tramcars—J. Bowring.
5,766 Train signalling and train control systems—C. H. Woodward.
5,769 Apparatus for controlling and stopping trains independently of drivers—A. F. Bound and W. Rowland.

AILSA OILSKINS

Give Genuine Satisfaction.

MOTORMEN'S COATS.

Write for sample of latest improved pattern, specially adapted to withstand the excessive friction at sleeves and under arms in driving.

The Manager of a well-known tramway company writes:—"Past results have been so satisfactory that we have this year decided to place the whole of our order in your hands."

AILSA OILSKIN CO.,

Manufacturers, Dalry, near Glasgow.

5,816 Device for indicating the number and position of seats occupied in a tramcar or motor omnibus—J. A. Donald.
6,099 Machines for grooving and boring railway sleepers—A. Collet.
6,114 Inserts for tramway tracks—T. Sheahan and H. J. E. Sayer.

Specifications Published.

1913.

29,219 Tramcar seats—Halloran and Dobbs.

1914.

5,321 Railway signalling apparatus—Wolff (*Fielding*).
5,538 Motor road vehicles—Fisher.
9,555 Vacuum brake apparatus—Richardson.
11,203 Apparatus for operating railway points—Swales.
15,504 Motor road vehicles—Greenwood and Jarratt.
15,769 Automatic vacuum brakes—Davis (*Bell*).
15,942 Laminated springs for railway engines and trucks—Slater.
18,756 Rail joints—Prahl.
21,551 Metal railway sleepers and rail fastenings—Brown.
3,622 Feedwater heating on locomotives—G. and J. Weir and Weir.
6,008 Apparatus for stopping trains independently of drivers—Hewitt, Gorst and Smellie.
6,299 Lifeguards for mechanically propelled vehicles—Conradi.
6,443 Brakes for tramway and railway rolling stock—Maley and Cadbury.
6,803 Detonator apparatus for railway signalling—Howard.
8,226 Lifeguards for tramcars, etc.—Philipson and Philipson.
4,131 Train electric control systems—Starie.
7,172 Safety appliances for motor omnibuses—Bonfield.
7,949 Spring retaining or controlling devices for tramway points or switches—Carnegie and Gladwyn.
11,912 Lifeguard and automatic brake for motor omnibuses—Bourn.
21,557 Rail joints—Cook.
21,764 Controlling device for carburetters for motor vehicle engines—Albion Motor Car Company and Murray.
4,956 Motor vehicle life-saver and accident preventer—Harwood.
8,066 Ticket punch—Darby.
8,249 Bogies for railway vehicles—Spencer.
8,432 Tramcars—Ashton.
8,817 Road vehicles—Edison Accumulators, Limited, and Monnot.
8,938 Brake mechanism—Fralich.
9,134 Electrically controlled block system for railways—Sayers, Acfield, Salt, and Cooke.
11,637 Tramway and railway points—Bradley and Fish.
12,721 Electrical signalling apparatus—Heyes and Heyes.
15,350 Railway ties or sleepers—Neily.

1915.

570 Traversers for railway vehicles—Stothert and Pitt, Limited, and Padfield.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. April 4.	April 11.	April 18.	April 25.	1915. WEEKS ENDED. April 3.	April 10.	April 17.	April 24.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	55.783	60.262	53.529	54.870	51.093	47.569	53.734	53.329	16	816.401	– 93.298
Auckland	(28 days) 23.552	(28 days) 21.702			(28 days) 19.932	(28 days) 20.216			40½	207.151	+ 3.027
Burma Rs.	4.559	4.184	3.669	3.949	3.625	3.678	3.473	3.758	...	...	– 38.774
Calcutta Rs.	68.814	66.024	66.488	65.808	60.528	62.354	63.993	61.405	17	1.132.902	– 71.273
Hong Kong $	11.444	10.799	10.841	10.683	9.978	10.122	9.874	10.198	17	182.077	– 20.572
Madras Rs.	(2 weeks) 32.782		(2 weeks)	30.297	(2 weeks)	28.604	(2 weeks)	30.370	17	228.061	– 4.966

Companies Issuing Monthly Statements.

	1913 Nov.	Dec.	1914. Jan.	Feb.	March.	April.	1914. Nov.	Dec.	1915. Jan.	Feb.	March.	April.	Wks.	AGGREGATE. 1915.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
BrazilianTraction Mlrs	6,009,487	6,142,209	6,194,227	5785027	...	...	5,929,730	6,010,490	5,996,190	5797500	...	...	9	11,793,690	– 185,564
Brisbane	27,053	29,145	28,330	25,260	...	...	28,600	30,890	29,620	26,590	...	...	9	56,210	+ 2,620
British Columbia $	746,152	793,219	777,102	704,003	...	...	648,485	674,063	640,495	558,512	...	...	35	5,197,906	– 836,925
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	...	14,147	14,646	13,342	13,922	...	...	15,869	15,660	13,924	15,829	...	13	45,413	+ 3,503
Carthagena& Herrerias	1,922	2,698	2,776	2,919	2,425	2,069	1,379	1,255	904	1,822	2,436	1,496	17	6,658	– 3,531
Cordoba	...	12,863	...	...	...	...	...	12,119	...	...	...	...	39	119,457	– 845
East India	1,922	2,046	1,938	1,701	1,884	1,837	2,029	1,839	1,914	1,649	1,846	1,864	39	17,240	+ 1
Kalgoorlie	2,504	2,907	2,340	2,169	...	...	2,414	2,905	2,372	2,352	...	...	9	4,724	+ 215
La Plata	5,409	5,505	5,296	4,766	5,178	4,716	4,540	4,452	4,540	4,016	4,269	...	17	17,407	– 2,549
Lima	33,236	38,091	37,870	33,779	34,665	...	29,749	32,112	33,042	30,173	34,180	...	13	97,395	– 8,919
Manila $	154,950	154,000	137,000	153,300	137,200	...	129,000	132,500	127,500	123,000	119,984	...	13	370,942	– 58,548
Melbourne	68,767	...	68,500	64,000	...	...	66,402	...	62,729	59,086	...	...	9	121,815	– 10,685
Mexico $	605,467	...	...	...	...	...	643,961	...	...	...	...	...	47	6,716,716	+ 378,911
Montevideo	30,531	33,310	38,256	35,805	32,630	29,650	27,081	28,605	32,443	30,007	29,716	26,786	26	174,655	– 25,526
Port Elizabeth	...	4,367	4,830	3,510	4,535	...	...	3,986	4,102	3,149	3,346	...	13	10,597	– 2,278
Puebla $	69,700	65,600	...	...	...	...	45,900	40,000	...	...	...	...	52	669,500	– 44,500
Rangoon	5,686	5,424	5,163	5,009	6,475	...	4,405	4,459	4,689	4,991	5,217	...	13	14,897	– 1,750
Toronto $	849,279	...	847,945	777,683	...	...	824,634	...	843,351	767,326	...	...	9	1,610,677	– 14,951
Winnipeg $	360,082	379,863	382,670	350,977	...	...	330,398	368,400	350,681	314,658	...	...	9	665,340	– 68,308

(*Continued on page 364*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	April 4	April 11	April 18	April 25	April 3	April 10	April 17	April 24	Wks.	1914–15.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1.458	1.516	1.662	1.704	1.508	1.626	1.620	1.602	47	76.970	+ 2.260
Accrington Corporation	493	649	759	581	487	650	528	512	3	1.690	– 299
Ayr Corporation	253	278	374	327	254	343	279	280	49	16.218	– 1.275
Bath Electric	*	...	...	...	...	...	...	...	–	—	—
Birkenhead Corporation	1.288	1.261	1.374	1.247	1.257	1.362	1.253	1.232	3½	4.561	– 230
Birmingham Corporation	12.525	12.380	14.362	12.253	12.038	13.994	12.286	12.440	4	44.419	– 2.336
Blackburn Corporation	1.168	1.219	2.154	1.411	1.117	1.632	1.167	1.167	4	4.960	– 788
Blackpool and Fleetwood	407	820	1.276	482	498	801	397	338	16	5.680	– 924
Blackpool Corporation	470	743	3.478	955	489	1.723	705	667	4	3.918	– 1.949
Bolton Corporation	2.652	3.536	3.011	2.936	2.754	2.776	2.611	2.516	4	9.727	– 1.694
Bournemouth Corporation	1.778	1.269	2.187	2.044	2.636	2.164	2.174	2.048	4	9.022	– 47
Bradford Corporation	5.862	6.231	8.094	6.404	5.659	7.521	6.475	5.849	4	22.769	– 1.750
Brighton Corporation	906	1.194	1.364	1.042	992	1.061	946	902	3½	3.550	– 702
Bristol	8.170	8.270	11.497	8.447	8.584	10.520	9.957	8.957	16½	139.227	+ 12.500
Burnley Corporation	1.625	2.071	1.835	1.588	1.699	1.733	1.541	1.465	4	6.438	– 681
Burton-on-Trent Corporation	271	317	327	298	248	300	267	262	4	997	– 152
Bury Corporation	324	1.734	1.525	1.408	431	1.447	1.329	1.242	3½	4.999	– 650
Cardiff Corporation	1.802	2.762	3.295	2.794	1.140	2.851	2.438	2.425	3½	8.855	– 1.799
Chatham and District	916	957	1.343	933	1.037	1.329	1.081	1.156	16	16.157	+ 2.248
Chesterfield Corporation	215	287	340	254	205	288	250	252	3	790	– 136
Colne Corporation	251	351	327	284	262	272	220	224	–	—	—
Cork Electric	483	491	523	542	429	513	481	484	16	7.132	– 294
Croydon Corporation	1.667	1.779	2.337	1.782	1.679	2.138	1.670	1.728	3	6.084	– 518
Darlington Corporation	95	258	296	248	123	280	249	237	3½	898	– 67
Derby Corporation	984	1.276	1.222	971	966	1.158	959	944	3½	3.614	– 297
Dover Corporation	...	252	302	235	...	299	273	269	3	1.000	+ 73
Dublin and Lucan	130	127	185	152	154	200	127	139	16	2.023	+ 42
Dublin United	5.794	5.371	6.248	6.088	5.653	6.960	6.326	6.101	16	81.985	+ 5.090
Dundee City	1.252	1.264	1.385	1.352	1.212	1.294	1.346	1.290	48½	62.096	– 1.322
East Ham Corporation	1.005	1.089	1.197	1.022	1.259	1.440	1.285	1.322	3½	4.631	+ 915
Exeter Corporation	...	330	479	362	...	414	329	331	3½	1.171	—
Gearless Motor Buses	*	...	...	...	...	...	...	...	–	—	—
Glasgow Corporation	21.948	21.191	21.572	22.345	20.438	21.029	21.206	21.560	46	952.485	– 9.585
Glossop (Urban Elec. Supply Co.)	115	134	139	128	119	130	116	115	17	1.873	– 196
Halifax Corporation	...	1.984	3.039	2.282	1.908	2.564	2.036	2.009	3	6.609	– 696
Hastings and District	776	799	1.618	1.114	746	1.074	915	932	16	12.243	– 566
Huddersfield Corporation	2.146	2.244	3.142	2.240	2.334	3.386	2.387	2.353	4	9.374	+ 260
Hull Corporation	3.171	3.309	3.453	3.123	3.034	3.289	2.981	2.981	3	10.726	– 1.146
Ilford U.D. Council	484	527	616	488	585	702	588	606	3	2.195	+ 365
Ilkeston Corporation	126	166	124	131	137	115	115	111	4	480	– 69
Ipswich Corporation	406	468	552	425	423	504	397	407	3	1.536	– 80
Isle of Thanet	375	577	873	512	324	469	326	339	29	8.745	– 2.235
Kilmarnock Corporation	163	173	163	170	156	157	162	161	49	7.813	– 750
Lanarkshire	1.882	1.851	2.030	2.259	1.706	1.866	1.833	1.944	16	28.260	– 1.854
Lancashire United	1.530	1.516	2.387	1.700	1.440	2.094	1.567	1.631	16	24.855	– 516
Leeds City	8.163	8.386	10.179	8.322	8.023	9.873	8.098	8.254	4	30.251	+ 47
Leicester Corporation	2.821	3.094	3.508	2.916	2.888	3.217	2.800	2.813	17	46.313	– 108
Leith Corporation	692	697	717	788	661	719	676	676	49	34.339	– 270
Leyton U. D. Council	...	...	1.841	1.359	..	...	1.545	1.594	3	5.076	+ 583
Liverpool Corporation	13.109	13.054	13.951	13.169	12.171	13.772	12.562	12.849	16	204.859	– 5.111
Llandudno and Colwyn Bay	181	239	534	264	290	473	324	326	20	4.337	+ 634
London County Council	42.853	43.567	47.496	43.452	46.464	51.417	47.777	48.996	3	148.189	+ 13.676
London General Omnibus	*	...	...	...	...	...	...	...	–	—	—
London United	*	...	...	...	...	...	...	...	–	—	—
Lowestoft Corporation	152	215	323	178	167	189	166	160	29	4.828	– 547
Maidstone Corporation	130	197	273	194	132	271	185	196	3	674	– 91
Manchester Corporation	17.631	17.895	19.231	18.089	16.182	18.567	16.868	17.566	3	60.708	– 2.113
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	–	—	—
National Steam Car	*	...	...	...	...	...	...	...	–	—	—
Nelson Corporation	...	389	230	211	...	351	155	169	3½	675	– 155
Newcastle-on-Tyne Corporation	5.055	5.399	5.988	4.884	5.888	6.132	5.995	5.821	3	20.916	+ 1.426
Newport (Mon.) Corporation	572	812	1.022	787	392	870	760	736	4	2.760	– 434
New St. Helens and District	786	756	1.161	814	877	1.278	890	950	42	38.759	+ 4.023
Northampton Corporation	553	544	754	564	652	799	633	626	3	2.223	+ 133
Nottingham Corporation	3.614	3.508	4.132	2.052	3.521	3.914	3.424	2.258	3	6.939	+ 65
Oldham Corporation	2.184	2.411	2.832	2.322	2.157	2.513	2.137	2.122	5	10.138	– 1.176
Portsmouth Corporation	2.155	2.393	3.130	2.303	2.183	2.697	2.455	2.408	4	8.715	—
Preston Corporation	...	805	1.055	861	...	1.037	856	896	3	2.789	– 784
Provincial	1.816	2.090	2.713	1.949	2.039	2.494	2.147	2.085	28	57.050	+ 5.450
Reading Corporation	566	698	865	697	553	799	722	691	3	2.334	– 24
Rhondda Tramways	1.230	1.270	1.854	...	1.086	1.572	1.202	...	15	17.052	– 1.271
Rochdale Corporation	1.525	1.981	1.889	1.623	1.687	1.912	1.540	1.539	3½	5.994	– 689
Rotherham Corporation	870	1.184	913	910	1257	997	976	978	4	4.210	+ 332
Salford Corporation	5.841	5.824	5.310	5.099	5.339	4.856	4.900	4.959	3½	18.794	– 872
Sheffield Corporation	8.012	7.892	8.647	7.697	8.117	8.986	8.226	8.034	4½	36.785	+ 1.030
Southampton Corporation	1.179	1.245	1.549	1.320	1.175	1.478	1.296	1.361	3	4.136	– 164
Southend-on-Sea Corporation	768	790	1.502	930	643	1.078	754	748	3	2.579	– 755
South Metropolitan Tramways	*	...	...	...	...	...	...	...	–	—	—
South Shields Corporation	700	841	849	748	772	831	691	706	3½	2.640	– 51
Sunderland Corporation	1.018	1.498	1.613	1.373	886	1.531	1.357	1.351	4	5.126	– 375
Sunderland District	587	542	803	595	534	769	559	569	25	13.252	– 1 125
Swindon Corporation	163	173	225	177	160	212	179	174	3	566	– 11
Torquay Tramways	462	469	1.126	...	451	808	577	...	15	6.696	– 124
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	–	—	—
Tyneside Tramways and Tramroads	501	509	586	511	514	655	550	547	16	8.232	– 111
Wallasey Corporation	1.161	1.222	1.534	1.269	1.057	1.384	1.117	1.124	3½	4.140	– 613
Walsall Corporation	612	648	867	589	656	863	633	653	17	10.952	+ 677
Walthamstow U.D. Council	289	853	1.090	810	409	1.024	770	806	4	3.003	– 34
Warrington Corporation	430	456	479	433	430	454	424	414	3	1.292	– 76
West Ham Corporation	2.772	2.874	3.452	2.801	2.926	3.394	2.898	3.012	3	9.747	+ 258
Wigan Corporation	1.599	1.977	1.836	1.457	1.657	1.912	1.406	1.451	3	4.774	– 481
Wolverhampton Corporation	1.033	1.402	1.099	1.019	1.293	979	996	983	4	4.252	– 301
Yorkshire (West Riding)	1.370	1.376	1.746	1.408	1.508	1.844	1.443	1.796	17	24.996	+ 668

* Publication of Traffic Returns suspended during the war.

ELECTRIC RAILWAY TRAFFIC RETURNS.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

The directory is revised as occasion requires, and is the most up-to-date and comprehensive list published.

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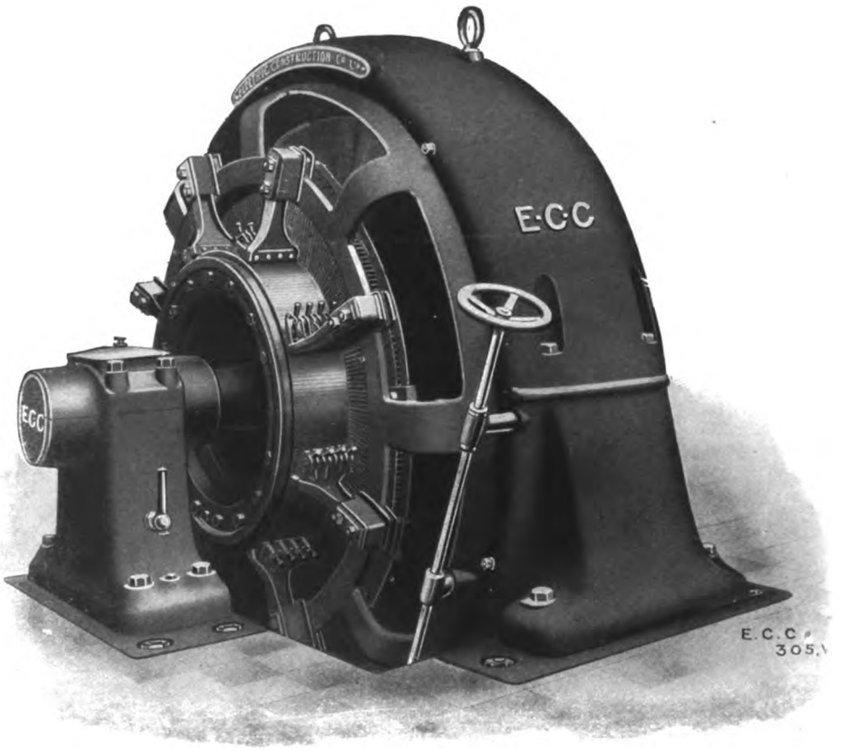

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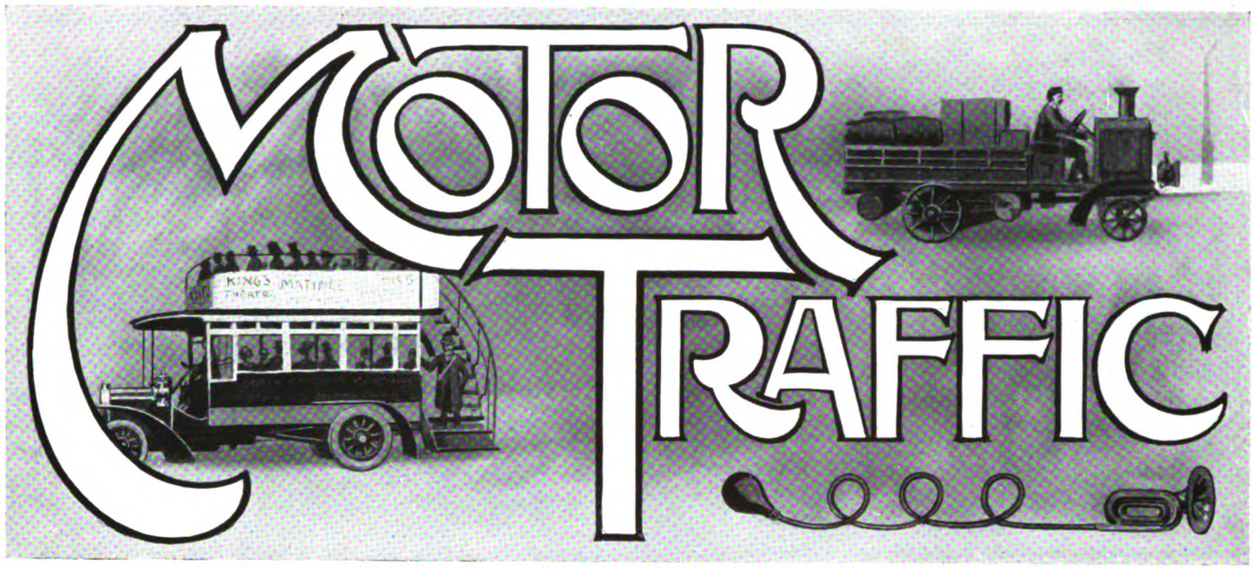

An important effect on the future of the heavy motor vehicle may be expected to result from the work of a special committee recently appointed by the Local Government Board. This committee is "to consider the law and regulations relating to the construction and use of road locomotives and heavy motor cars in Great Britain, and to report what amendments, if any, are desirable." All the interests affected have been given representation on the committee. The Commercial Motor Users' Association, with which are affiliated the Commercial Motor Users' Associations of North and East Lancashire, Manchester, Liverpool and Counties, and the West Riding, has undertaken to present the case for the two classes of vehicle, and for that purpose Mr. F. G. Bristow, the secretary, has asked the members to furnish answers to the questions embodied in the first schedule issued by the committee. The general results obtained therefrom will be submitted in evidence. That heavy motor traffic has attained an importance far beyond the out and home day journeys from great towns was shown by the issue more than a year ago of the Association's Handbook of Night Shelter Accommodation, which contains street plans of the chief towns, with particulars of depots, market-places, and hotels approved for night shelter accommodation. In consequence of this growth and the evolution of steam and petrol vehicles to speeds and capacities not thought of when the Heavy Motor Car Act came into force, the appointment of the Local Government Board Committee is a step in the right direction, even though its origin is to be traced to the action of local authorities in urging the imposition of heavier taxation of the vehicles in order to meet the cost of road maintenance. As far as steam wagons and tractors are concerned, we believe it will be found that the Association does not expect that the present scale will continue, and that the owners of these machines will probably not object to reasonable taxation, coupled with exemption from the risk of claims for road damage. On the question of higher rates of taxation for petrol lorries, etc., the members are asked whether they approve of an increase, provided axle weights of above eight tons can be sanctioned by law, and what is such excess worth? Whatsoever may be the character of the recommendations to be submitted by the Local Government Board Committee, the members thereof ought to be guided in their conclusions by the inestimable value of the work performed by heavy and light motors for the cause of the Allies in France and Belgium. That work is worthy of all the recognition that can be given by the Government in the form of increased grants for road maintenance rather than by taxation of the vehicles.

* * * * * *

One of the biggest problems of motor users in this country within the next few weeks is likely to be the serious shortage of really skilled drivers. During the first few days of the war there were plenty of men in a state of anxiety as to the possibility of finding work, owing to their vehicles being requisitioned. Even recently there was strong evidence in favour of the supposition that there were more available drivers than military lorries for them to drive. At the time of writing we have, however, reached a new phase. Doubtless an accumulation has been made both of lorries and of drivers in view of the stage reached in the training of large sections of the new armies. When the time comes—as it must come very soon indeed—for these armies to move, the possibility of utilising them promptly will be dependent on the perfection of their equipment in every respect. We have heard a great deal about the dangers of a shortage of ammunition, but a shortage of the means for bringing that ammunition up to the front is just as serious a matter. Consequently there is at the moment a huge and urgent demand for thoroughly skilled drivers. The terms offered for enlistment of drivers in the A.S.C., M.T., are very generous, amounting to six shillings a day, with excellent separation allowances for wives and families. If the needs of the troops are to be met with the least possible dislocation of business, it is to the chauffeur in private employment that we ought to look for prompt action. At the same time, the pecuniary inducement, coupled with the natural desire that most men feel to serve their country, is likely to draw off considerable numbers of drivers from commercial employment. In any case, if there is no definite shortage in quantity, there will almost inevitably be a lowering of quality, since it is imperative that the army should have the services of really skilled men, and the opportunities which were open only to partially trained men in the hurry of the outbreak of war no longer exist.

* * * * * *

It will probably be advisable in every case where such a course can at all conveniently be arranged, that industrial motor users should take every opportunity at once of sending out intelligent men with their best drivers, with a view to their being trained in the essentials of the steering and control of a car. A really

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MOTOR TRAFFIC.

good driver-mechanic cannot be casually manufactured in a few weeks. Neither is it probable that the genuine article would be anxious to jeopardise his own future by training other men to compete with him. On the other hand, a skilled driver going out on military service would feel safer if he knew that his work was being taken over for the time being by a novice trained by himself than if he remained in doubts as to who would take up his job. There is one more point which needs emphasis, and this is that if drivers enlist because the country needs their services, employers should make it clear that they are prepared to enter into an honourable engagement to take these men back when the war is over. Men cannot be expected to do their duty to the country if they are discouraged by the possibility or the certainty that their job will be filled by someone else when they return.

* * * * * *

One of the most interesting developments in the military uses of the motor vehicle over and above those anticipated in the first instance has been the surprising diversity of machines employed for various services directly or indirectly connected with the preservation of health among the troops. The food supply has, as we are all aware, been more than adequate, and a very large share of the credit for this result is entirely due to the motor. The effect of sufficient and punctual meals of fresh meat as compared with an irregular service of tinned and preserved foods cannot be other than very beneficial to health, and likely to check altogether certain diseases that in previous campaigns have been very prevalent. Those who were conversant with the capabilities of the industrial motor vehicle could, however, fully anticipate the excellent results that have been obtained. On the other hand, few, if any, had more than a vague impression of certain other possibilities that have recently materialised. We may instance, for example, the bacteriological laboratories fitted up on motor chassis, and containing all the necessary apparatus for those investigations which are so essential if epidemic diseases are to be avoided. It speaks highly for the chassis employed, and especially for those designed to run on solid tires, that the delicate scientific instruments required for this work can be carried with such impunity over broken roads.

* * * * * *

The French army is in possession of some very interesting little motor convoys organised by a well-known surgeon. Each convoy consists of about three cars and a lorry. The former carry all the material for the erection of a considerable tent that can be used as an operating theatre, and can be shifted to any point on the line where, at any particular moment, there may be a great need for it. By the time the tent has been erected, the lorry, moving more slowly, arrives with the surgical apparatus and a big steam generator which provides large supplies of hot and sterilised water. The French also have some Paris motor 'bus chassis equipped with very long bodies divided into three compartments. The main central compartment is in this case a small operating room, while of the smaller compartments one contains the surgical appliances, and the other an installation for sterilising water by the use of ultra-violet rays. The Germans have in service some cars very completely equipped with X-ray apparatus for surgical work. They are also using other cars fitted up as travelling dispensaries, and employed to take the medicines and dressings right up to the men in the trenches.

* * * * * *

The subject of health is closely connected with the cleanliness of the person and of garments. Here, again, the Germans must be given credit for a good idea in their motor field laundries. In this case the equipment consists of a powerful tractor and three trailers. The tractor carries a steam-driven mangle, and the first two trailers contain the copper, the drying press, the washing machines and pumps, and a disinfecting vessel. The third trailer is devoted to general stores. Perhaps the principal point to be noted in this installation is the disinfecting vessel for cleansing blood-stained garments or clothes infested with vermin. So far as our own motor auxiliaries are concerned, the latest thing is a bathroom capable of supplying hot baths at the rate of twelve every twenty minutes or so, and also of fumigating very thoroughly some thirty suits of clothes in a little over an hour. The equipment of this car is adapted for the sterilising of water. It is quite likely however, that special vehicles will have to be employed, devoted solely to this latter purpose, and dependent on the heating and subsequent cooling of the water by some simple means. In many instances filters have proved inefficient owing to internal breakages, and delicate apparatus — suitable enough under other circumstances—has failed, and allowed water to pass through without being really thoroughly sterilised. These notes merely touch upon some points of the work that has been done in the course of a few months. They represent, however, an indication of beginnings which, during the coming summer, may develop into very extensive as well as important movements.

DENNIS SUBVENTION TYPE MOTOR LORRIES.

The British manufacturer is accused of slowness, lack of adaptability, and conservatism in outlook and method. We must admit that there has been just enough truth in the accusations to give them sting. Here, however, we have a catalogue from one of the oldest motor engineering firms in the country, which is up to the moment and fully abreast of the needs of the time. At the beginning of the war, in order to ensure an adequate supply of reliable motor vehicles for the use of the transport and supply columns, the War Office instituted a subsidy scheme, framed so as to encourage motor users to employ a high-class of vehicle of uniform type, offering a subsidy to owners of motor lorries which conform to the specifications of the War Office. Messrs. Dennis Brothers, Onslow Works, Guildford, have produced a type of motor lorry which conforms in every detail to the War Office specification, and issue a special catalogue designed to bring the vehicle to the notice of possible purchasers. The catalogue is both attractive and instructive. On the outside cover is a coloured picture of a gallant show of motor lorries driven by khaki-clad drivers along a pleasant country road, bringing out clearly the details of the vehicles. The catalogue opens with an article on "The Subsidy Scheme: What It Is and What It Does," indicating the principal points of the War Office scheme from the point of view of the motor purchaser, and describing the special features of a good motor lorry of subvention type. A short and pointed summary is given of the arduous conditions motor lorries must be fitted to endure. The greater part of the catalogue is taken up with a specification of the Dennis War Office subvention A type chassis for gross loads of 4½ tons. The specification is full of very useful technical details, but the terms used are so simple and the statements so clear that even the ordinary reader will find it interesting. Half-tone reproductions of important mechanical details and drawings of chassis and coach bodies illustrate the subject in such a way as to satisfy the requirements of the trained engineer, and at the same time appeal to the user of industrial motors who, as a rule, is able to appreciate good features of design when his attention is called to them. A list of the principal users of Dennis industrial motors completes the catalogue.

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MOTOR TRAFFIC.

FOUR-WHEEL DOUBLE WORM-DRIVEN TRACTOR.

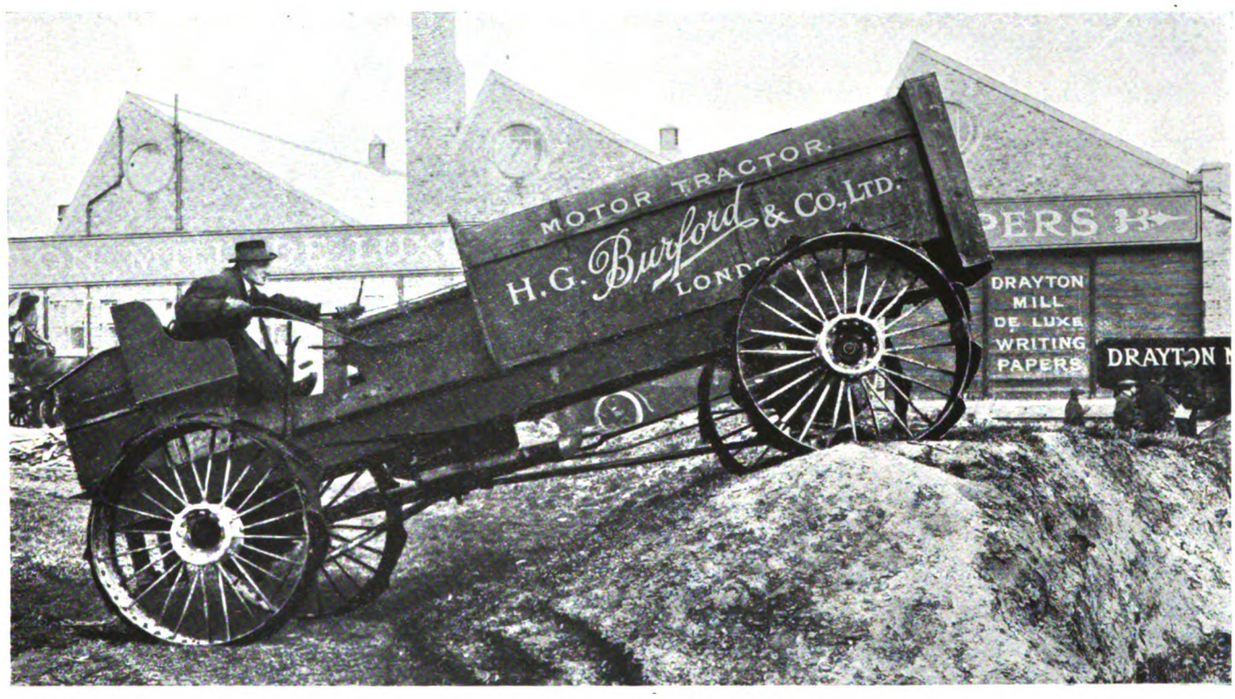
The demand for motor tractors for service in connection with army transport is an ever-increasing quantity, and it is obvious that as progress is made by either of the allied armies, and greater distances have to be covered, the service of motor vehicles will have to be still further augmented and increasing difficulties overcome. In these circumstances it is not surprising to find that a ready welcome has been accorded to the powerful four-wheel-driven tractor of which we are now able to give a brief description.

As will be seen from the illustration, which shows the machine under test at South Park, Fulham, the question of good roads does not enter into the proposition at all, as each pair of wheels are worm driven and can be separately steered. The machines are the product of the Morton Tractor Company, of Harrisburg, U.S.A., and are being introduced to this country by H. G. Burford and Company, Limited, of 11, Waterloo Place, S.W., and we understand that so satisfactory were the series of trials carried out at Fulham that the agents for the Russian Government have already placed orders for 180 machines.

The engine fitted to these tractors is of the usual 4-cylinder vertical type, 5¾ in. bore × 7 in. stroke, developing 80 H.P. at 800 revolutions per minute. The magneto and ignition wiring is all enclosed in a dust and waterproof casing, as is also the dry cell battery unit. An adjustable governor of the fly-ball type ensures the perfect regulation of the engine at all speeds. The cooling is maintained by means of a large circulating pump in connection with ample water spaces, and a radiator of heavy gauge galvanised tubes. The latter is mounted on a wooden platform which in turn is mounted upon a spring suspension, in order to obviate all strains and stresses. The clutch is of the universal type of multiple disc operating in a bath of oil. The housing to this clutch is made oil-tight, and when once filled with oil can be operated for months without any attention whatever. The clutches are made adjustable so that the wear of the discs can be taken up; this is accomplished by taking out a cotter pin and turning a lock nut one quarter turn. Operated by a lever, the clutch will at all times engage itself, unless the hand lever is thrown to a neutral point, when it engages with a safety device. The gear box gives three speeds forward and one reverse, and is of the Morton heavy selective gear type, controlled by two levers. The bearings used are all of the spring roller type, packed in grease with a hard grease cup attached to each bearing for further lubrication when required. The gear wheels, which are of nickel steel cut from the solid, are always in mesh, being engaged and disengaged by means of dog clutches. The steering mechanism is also housed in the gear box, and consists of a worm and worm wheel and two bronze clutches. The whole of the gear operates in a bath of oil or grease, and it is claimed that once the box is filled with the proper amount of lubricant it will last for a period of from eight to twelve months without any attention.

The steering gear, which can be operated in either direction, is also engaged or disengaged by means of a bronze clutch, to which is attached the hand lever. The steering is controlled by means of a worm meshed into a worm gear mounted on a vertical shaft, which extends through the bottom of the gear housing, on which extension is secured a sprocket wheel; this works a sprocket chain, which is connected to each end of the axle, so that by operating the worm wheel forward or backward the axles may be turned to any desired angle.

The driving shaft extends from the front axle to the rear axle, passing directly through the transmission gear box, and on each side of this there is a universal joint to which is attached the shaft running to the centre of each axle. At the end of each driving shaft there is also a universal joint, normally in the centre of the axle, thus permitting the free movement of the axles and the drive of all four wheels. Each of these joints is packed in grease and has oil holes for further lubrication. A distinctive feature of the drive



Burford Double Worm-Driven Tractor.

is that the shafts operate in a straight line, except when the machine is running over very rough surfaces, and even then at a very small angle. Both the front and rear axles are of the same construction, with the exception that the front axle is fitted with a universal joint connection between the axle and frame, which permits it to work at an uneven plane from the rear axle.

The axle housings are made of high-grade cast steel specially heat-treated to give a high tensile strength; they are constructed in three parts, the main part being divided longitudinally with a separate section for the worm gear. The worm is of the Hindley type, and is made of 3½ per cent. nickel steel; this is heat treated, hardened, and ground to size, and is mounted upon ball bearings, the worm gear being of phosphor bronze. The differential gears are of the usual type, consisting of two bevel gears and four pinions of high carbon steel.

The frames of these tractors are of exceptional strength, and are made up of 14 in. channel steel with cross members at either end. Heavy steel castings are bolted to the side members at the location of each axle, the gear box casing and the motor sub-base being also attached thereto in a similar manner. The springs are

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MOTOR TRAFFIC.

connected by cast steel housings to the axle housings proper; it is claimed that great resiliency and flexibility is thus obtained. The wheels are of the suspension type, 72 in. in diameter and 18½ in. wide, with wrought-iron cleats on the face of the wheel. The overall length of the tractor is 15 ft. 8 in., with a wheel-base of 11 ft. 3 in., the overall width being 6 ft.

As will be seen from the illustration, the cab is situated at the rear end of the tractor. This is provided with seats conveniently placed for operating the controlling levers, and has a capacity for seven persons. As the tractor is intended for service in all climes and under all circumstances, due regard has been paid to the protection of the operators as well as the working parts of the machine; thus the cab is fitted with windows and curtains, while a hood covers the motor and all moving parts, including the petrol tank and clutch mechanism, in such a manner that it is impossible for water, dirt, or sand to penetrate.

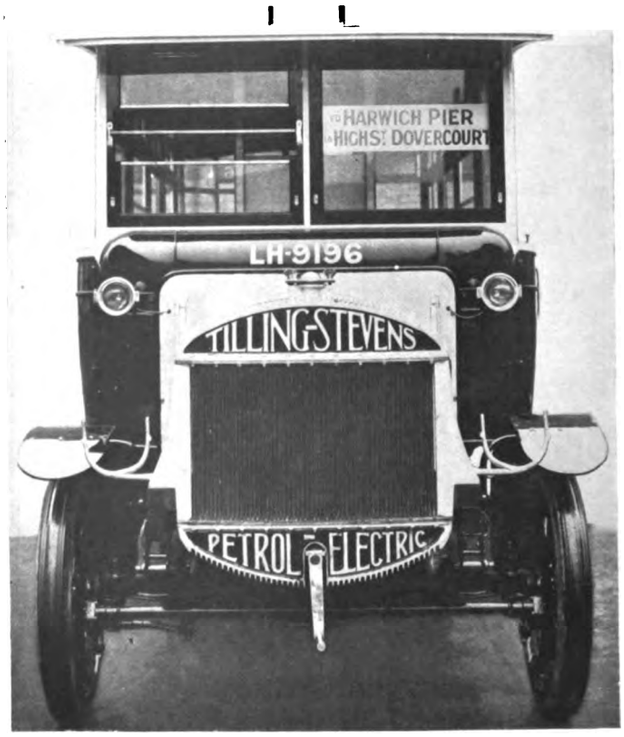
It is claimed for these tractors that owing to the four-wheel double worm drive, the simplicity of manipulation, high efficiency of lubrication, and the fact that all parts are protected from foreign matter, travelling over ground usually considered impassable can now be regularly negotiated with absolute certainty, and this with loads up to 10 tons per tractor. We understand that excellent service has already been rendered by these vehicles in various parts of the world, notably in South America, so that apart from the demand for war purposes, which is likely to continue, there should certainly be a wide field for their service in the Colonies and all parts of the world where the absence of good roads has hitherto hampered the progress of mechanical traction.

SOME TILLING-STEVENS VEHICLES.

Three of the most recent deliveries of the Tilling-Stevens petrol-electric vehicles are illustrated on this page, and give some idea of the variety of the service of which these well-known machines are capable. The first illustration shows a single deck omnibus running at Harwich, which is one of several now in the service of the Great Eastern Railway. This vehicle has seats for 30 passengers, and embodies a number of interesting points. The side windows are easily removable for summer weather, and the vehicle is lighted by electricity. It is handsomely upholstered and in every respect a comfortable omnibus. The second illustration below shows a lorry owned by the Medway Milling Company. This is one of many vehicles supplied to the milling industry, and is capable of carrying a net load of four tons. The body was built by Messrs. Thomas Tilling, Limited, at their works in Wren Road, Camberwell, and is very popular for work of this kind, being specially designed for the trade. Similar bodies are being used on chassis recently supplied to Messrs. Cannon and Gaze, millers, of Erith, and Messrs. T. S. Townshend and Sons, Limited, millers, of Worcester.

control, and the one on the near side the shunt resistance lever, which is only used by the driver when negotiating steep gradients and more power is required.

The chief feature of this system is the elimination of the clutch and gear box and the substitution of a flexible electrical transmission between the engine and driving wheels. The final drive in the Tilling-Stevens vehicles is effected by an electric motor, driving by



Great Eastern Railway Omnibus.

means of a cardan shaft the worm gear on the back axle. The electrical supply for the motor, instead of being provided by a battery, as in the ordinary type of electrical vehicle, is supplied by a specially-constructed dynamo, direct coupled to a petrol engine

Tilling-Stevens Petrol Electric Vehicles.

The vehicle shown in the other illustration is one of several which have been supplied to the War Department for transport work, and is capable of dealing with a net load of four tons. Similar vehicles have also been supplied to the Admiralty.

To those who are unacquainted with the Tilling-Stevens petrol-electric designs, the War Office model will no doubt be of interest, as it shows very clearly the control levers which are fitted to the steering column, that on the off side being the actual lever of which is the mechanical source of supply. It is claimed for this system that the generating plant develops considerably more electrical energy than is contained in a battery four times its weight, the result being a speedy vehicle of extreme flexibility and silence, quite independent of charging stations, and possessing great powers of acceleration. These petrol-electric vehicles are becoming increasingly popular both for passenger traffic and the delivery of goods of all kinds.

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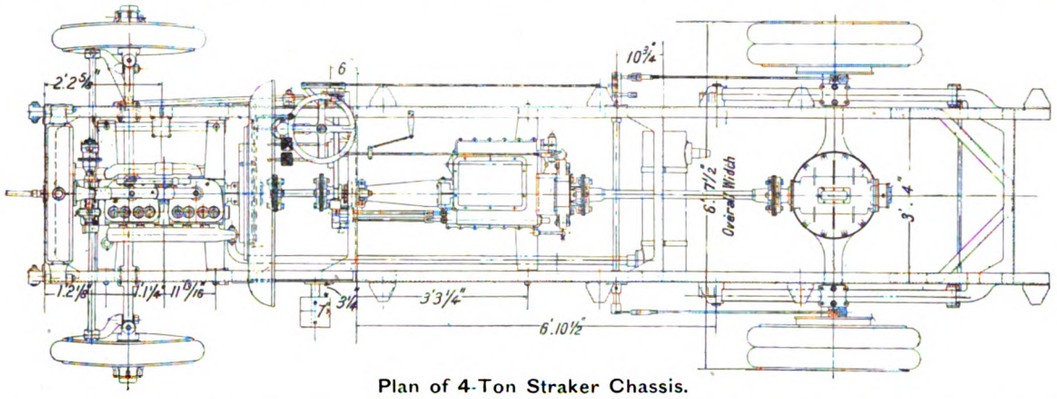
MOTOR TRAFFIC.

STRAKER-SQUIRE WAR MODELS.

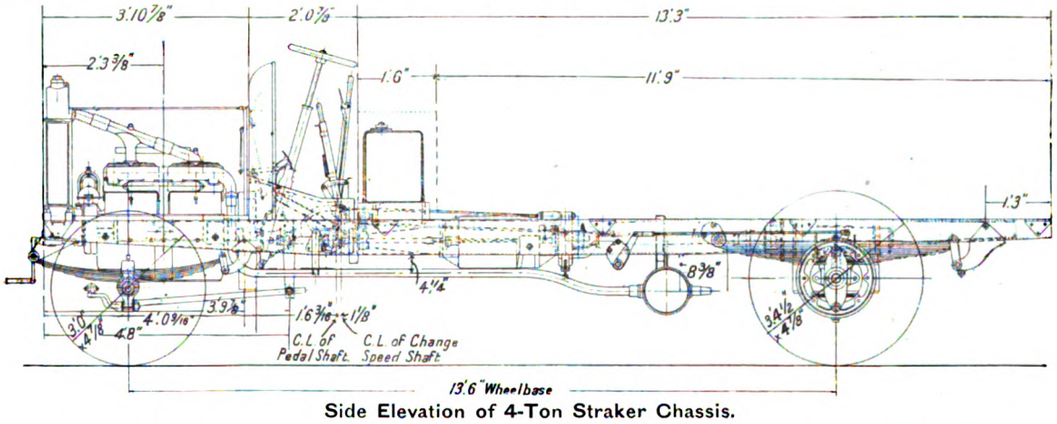
In common with the leading manufacturers of industrial motor vehicles, Straker-Squire (1913), Limited, of Nelson Square, London, S.E., are still working at high pressure in order to meet the demand of the War Office for the supply of their chassis for service in the transport and ambulance sections of the army organisation. The two models for which Messrs. Straker and Squire have arranged practically an automatic delivery are the 2 tons, known as the C.T K., type and the 4 tons or C.O. type. The former of these has been fitted with a special ambulance body which, although from the outward appearance quite on the orthodox lines, is in its internal equipment the latest development in hospital ambulance work. The capacity of the standard machine is usually limited to the carrying of four wounded and an attendant; the new type of ambulance van, however, a fleet of which is shown in an illustration, is so arranged that no less than 14 lightly wounded, four badly wounded on stretchers, and four attendants can all be conveyed at one and the same time. This result has only been obtained by much thought and careful experiment, with the active assistance of the War Office authorities, under whose supervision the whole of the experiments were carried out. The importance of the rapid movement of wounded troops is so great that it is impossible to over-rate the value of the new Straker-Squire machine, which has practically five times the capacity of the ordinary ambulance van.

Although of ample strength for its load—and in this connection it should be said that in each of the Straker models the load-carrying capacity is given as a nett paying load and does not include the body—the 2 tons chassis is claimed to be one of the lightest on the market, the gross weight, including tires, being under 35 cwts. The frame is of channel section, and has an over-all length of 18 ft. It is strongly gussetted and cross tied and is suspended on almost flat leaf springs, the fore ends of which are anchored on the pivot principle to the side members of the frame, while the usual shackles connect the rear ends. Special care has been taken in the design of the springing arrangements in this model with a view to obtaining that smooth, sweet running so desirable in ambulance work under normal conditions, and especially so when the vehicles are operating under circumstances which prevail on the battlefield at the present time, where shell fire has torn up whole stretches of country and the rain-soddened roads have been ploughed to their foundations by the passage of heavy guns and transport wagons.

The engine fitted to this chassis is of the 4-cylinder 25 H.P. vertical type, the cylinders being 95 mm. bore by 128 mm. stroke cast *en bloc*. The inlet and exhaust valves are interchangeable and are mechanically operated, being all located on the same side of the cylinders. The crank shaft is of high tensile steel, and has a bearing between each crank. Automatic lubrication by means of a gear-driven pump, situated in the base of the crank chamber, ensures a perfect supply of oil to all wearing parts, a tell-tale on the dash enabling the driver to see that the levels are maintained. The thermo-syphon system of cooling with air drawn through the radiator by a belt-driven fan is found to be most efficient. The carburetter is the "Ware" automatic gravity-feed type, the ignition being by high tension magneto driven by gearing from the cam shaft. The transmission is by leather-faced cone clutch of large dimensions, furnished with a self-contained thrust spring and a ball thrust to a 4-speed gear box, the direct drive being on the fourth speed. The gear shafts are all mounted on ball bearings and the gears are operated by a single lever working in a gate. The transmission from the gear box to the back axle is by cardan shaft and worm and worm-wheel gearing. The worm is of case-hardened steel and the worm wheel of hard phosphor bronze. The live axle comprises a main forging in high tensile steel, carrying in the centre the entire worm and worm wheel and differential all mounted in one steel casting, with an aluminium casting at the bottom forming a cover. By this method of construction the worm drive and differential can easily be removed for inspection. The road wheels rotate upon the tubular section arms, the drive being transmitted through two shafts direct to the wheels. It will be seen, therefore, that no portion of the weight of the vehicle or its load is taken by the driving shafts, whose only function is to drive the vehicle. The differential gearing is of the bevel type. All the bearings in the back axle are fitted with balls with ample ball thrust, the driving wheels running on plain bushes. Two independent sets of brakes and drums are provided, both acting on the back wheels. These are internal expanding acting upon enclosed drums, and can readily be adjusted by turn buckles in the pull rods. One set is operated by a hand lever of the pull-on type and the other by foot pedal, the coupling rods in both cases



Plan of 4-Ton Straker Chassis.



Side Elevation of 4-Ton Straker Chassis.

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MOTOR TRAFFIC.

being outside the frame. The mounting of the brake shoes and other details is so arranged that the road wheels can be removed without in any way upsetting the adjustment of the brakes.

The 4-ton model, of which we are able to give two novel illustrations from photographs taken "somewhere in Flanders," where the machines are doing yeoman service in helping to feed the Belgian Army, has many things in common with the smaller model. The engine, however, while similarly arranged as to valves, etc., has its cylinders cast in pairs, 4½ in. bore by 5 in. stroke. The crank shaft runs on three white metal lined bearings and the crank case is so arranged that the bottom portion can be dropped without interfering with the crank shaft bearings. The carburetter, magneto, and systems of lubrication and cooling are identical with the smaller chassis, but the air cooling of the radiator is supplemented by means of vanes mounted upon the periphery of the fly wheel. The mounting of the engine and gear box also differs somewhat in the larger model. There are four radial bearers for the engine, but only two, those on the near side, are directly connected to the frame. The corresponding pair are held in position by a bar fore and aft carried centrally by lugs projecting from the side frame. The change speed gear box is mounted upon what is known as the three point suspension system, a cross frame member carrying the central point. All the details of frame construction, mounting, dimensions, etc., can easily be seen by references to the plan of the chassis, together with the elevation drawing shown on page 371. In the larger model the foot-operated brake is placed behind the gear box and comprises a drum bolted to the cardan shaft, upon which a pair of fibre-faced shoes operate externally, each being

4-Ton Straker Model in Flanders.

A Fleet of Straker Motor Ambulances with 2-Ton C.T.K. Type Chassis.

A Straker Van at the Front.

provided with a local adjustment as well as a separate adjuster to the tension rod. The standard size of platform for the 4-ton model is 12 ft. by 6 ft. 6 in., but this can be extended to take single deck omnibus and char-a-bancs bodies up to 15 ft. by 7 ft. if desired.

Quite apart from the chassis here illustrated, we understand that Messrs. Straker-Squire have just brought out a new 1915 model, which will shortly be offered to the market as their "last word" in the way of "public service" vehicles for public service work, viz., a 14 ft. 6 in. as a standard and is, therefore, particularly suitable for single-deck 'bus work where a large number of passengers have to be seated on one plane. It has a 50 H.P. engine fitted with all improvements that their long experience of 'bus work has taught during the last 14 years. They have departed from their usual practice and fitted it with governor gear cutting out at about 1,150 revolutions. All universal joints are now of a special type of leather joint, instead of pin joints, and we think it will be found to be one of the most silent and efficient public service vehicles ever put on the market.

Somewhat on the lines of this large machine, they have also brought the smaller patterns into line with the general outlines of their design. The "junior" has a 25 H.P. engine of 95 mm. bore by 128 mm. stroke, 5-bearing crank shaft, exceptionally large diameter crank pins and journals; each segment of the crank case divided off with a separate wall. The cone clutch is "ferrodo" lined, and is of the self-contained type with no end thrust. Double universal joints between engine and gear box are provided. The gear box itself contains among other new features an absolute locking device for the gears.

As regards the frame, in lieu of the inswept pattern, a parallel one is now being adopted, and the sub-frame is in one piece with the main frame.

The merits of Straker-Squire design seem to be catching the eye of large administrations generally, as the company recently had official notification, as reported in another column, from the Metropolitan Asylums Board that they have selected Straker vehicles from among a very large number of important tenderers

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MOTOR TRAFFIC.

TIRE MILEAGE GUARANTEES.

For some time past efforts have been made to secure the adoption of a standard form of guarantee amongst the solid tire manufacturers. It is, therefore, pleasing to note that the movement has met with success, and that a form of guarantee has been agreed upon and adopted by over 20 of the leading firms. The form of the guarantee is as follows:

Solid rubber tires supplied for use in the United Kingdom are guaranteed for 10,000 miles' service.

We undertake that on a claim being admitted by us the tire will be repaired free, or replaced at a charge proportionate to the failed mileage or unexpired time at our option, and in cases where tires are so replaced, the failed tires become our property.

This guarantee is given subject to the following conditions:—

1.—Claims under the guarantee must be made within 12 months from the date of the sale of the tire by us.

2. The vehicle to which the tire is fitted shall be maintained in good running order, shall not be run at excessive speeds, the brakes shall not be so applied as to cause the tires to "skid," and no error in wheel alignment shall be permitted.

3. The total load shall not at any time exceed that set out in the Schedule below for the respective sections of tires.

SCHEDULE OF LOADS.

Section of Tire.	Maximum Load per Tire.	Section of Tire.	Maximum Load per Tire.
75 mm.	10 cwts.	120 mm.	27 cwts.
85 ,,	13 ,,	130 ,,	31 ,,
90 ,,	15 ,,	140 ,,	33 ,,
100 ,,	19 ,,	160 ,,	38 ,,
110 ,,	23 ,,		

4.—No liability will be accepted by us for accidents to vehicles, property, or individuals arising in respect of vehicles fitted with tires, the subject of this Guarantee, and this Guarantee is given instead of and expressly excluding any kind of implied condition or warranty, and the damages for which we make ourselves responsible hereunder are limited to the replacement of failed tires as above-mentioned.

5. And such other conditions as may be set out in our terms of sale.

NOTE.—The guarantee in the above terms may be extended at the option of the tire maker to cover tires supplied to countries outside the United Kingdom, providing that the mileage guaranteed shall not exceed 10 000 miles, and a period not more than 12 months from the date of the tires reaching the purchaser in the country in question

MOTOR VEHICLES FOR MUNICIPALITIES.

The question of the relative advantages of motor transport as compared with horse service was never so pressing than at the present time. The constant call upon the able-bodied workman of the unskilled class has so restricted the supply that in many towns it is with extreme difficulty that even a restricted service in the street cleansing department can be maintained. Under these circumstances it must be admitted that a system that will facilitate the performance of the necessary duties that devolve upon the various municipal authorities, and at the same time make it unnecessary to employ anything like an equal number of men, must commend itself to all those responsible for these departments. The majority of the county and municipal councils have already recognised the value of motor vehicles in one form or another, and especially is this noticeable in regard to fire-fighting appliance. Amongst the latest movements in the "public service" field are the following:—

BLACKBURN CORPORATION have decided to purchase a motor ambulance.

WOOLWICH BOROUGH COUNCIL have decided to purchase two motor sweepers.

HULL CORPORATION propose to spend £2,050 on motor ambulances and £650 on a motor car.

SOUTHAMPTON CORPORATION have decided to purchase a motor fire engine and also a steam wagon.

SHEFFIELD CORPORATION have under consideration the question of installing motor vehicles for the collection of street refuse.

LEIGH CORPORATION are seeking Parliamentary authority to run motor omnibuses both in and outside their borough boundary.

OLDHAM CORPORATION have adopted the recommendation of the Tramway Committee to extend their motor omnibus service.

HULL CORPORATION have under consideration a recommendation from the Works Committee for the purchase of a steam wagon.

SOUTH SHIELDS CORPORATION have appointed a sub-committee to consider the merits of petrol and electric refuse collecting vehicles.

ACCRINGTON CORPORATION have under consideration a recommendation of the Watch Committee to purchase a motor fire engine.

SHEFFIELD CORPORATION HEALTH COMMITTEE have invited tenders for a one-ton van, which may be either of the petrol or electric type.

HINCKLEY URBAN DISTRICT COUNCIL have under consideration a recommendation from the Highways Committee to purchase a motor lorry.

WALLSEND CORPORATION have accepted the tender of Armstrong, Whitworth and Company, Limited, for the supply of a motor ambulance.

HOYLAKE AND WEST KIRBY URBAN DISTRICT COUNCIL are seeking information with regard to the first cost and maintenance of motor fire engines.

ALDERSHOT URBAN DISTRICT COUNCIL have received the sanction of the Local Government Board to purchase two motor vehicles at a cost of £1,200.

HOVE TOWN COUNCIL have granted twelve licences to Thomas Tilling, Limited, for the operation in the district of Tilling-Stevens petrol-electric omnibuses.

HENDON URBAN DISTRICT COUNCIL have under consideration a recommendation from the fire brigade committee for the purchase of a motor fire engine.

PORTLAND URBAN DISTRICT COUNCIL have been advised by their highways committee to purchase a tractor and wagons out of the general district fund.

EDINBURGH TRAMWAYS COMMITTEE have appointed a sub-committee with instructions to collect the fullest information with regard to self-propelled rail cars.

YEOVIL CORPORATION have received tenders for a 4-5 ton steam or petrol chassis provided with an end tipping body and water tank with 1,000 gallons capacity.

HALIFAX CORPORATION have appointed a sub-committee to consider the advisability of purchasing two motor vehicles for service in the highways department.

GLASGOW CORPORATION have just added a Green motor sweeper to their street cleansing department, and are expecting the delivery of a number of similar machines from the Facre Motor Car Co.

WARRINGTON CORPORATION have under consideration a report from the Borough Surveyor recommending the substitution of motor vehicles for the present horse-drawn vehicles in his department.

PLYMOUTH CORPORATION have just taken delivery of a 3-ton steam wagon built by Mann's Patent Steam Cart and Wagon Company, Limited, of Leeds. This vehicle, which is mounted upon rubber tires, completes a fleet of eight now in service.

THE WAR OFFICE announces that the following tenders were accepted during the month of February:—Austin Motor Company (1914), Limited, the supply of motor cars; Leyland Motors, Limited, D. Napier and Sons, Limited, and W. A. Stevens, Limited, motor lorries.

ROCHDALE CORPORATION have received an intimation from the Local Government Board with reference to the application for powers to borrow £500 for the purchase of a motor ambulance, to the effect that it is not desirable that the money should be spent at the moment. The matter is somewhat complicated by reason of the fact that the order had already been placed.

TIRES FOR METROPOLITAN ASYLUMS BOARD.—The Avon India-rubber Company, Limited, and Shrewsbury and Challiner Tire Company, Limited, were the successful tenderers to the Metropolitan Asylums Board for pneumatic tires. The Dunlop Rubber Company, Limited, and Shrewsbury and Challiner Tire Company, Limited, have arranged contracts with the Board for the supply of solid tires.

SKEFKO BALL BEARINGS COMPANY.—Few manufacturers have been more sorely taxed to meet the enormous demands of the engineering and allied trades during the past year than the Skefko Ball Bearings Company, Limited, of Luton. But for the fact that the English company has been able to call upon the parent company to assist them in meeting this demand for "Skefko's," much disappointment and delay would have been caused. Bearings equivalent to five times the maximum output of the English works are, at the present time, being delivered to the English company from the parent works to assist them in fulfilling their contracts. This assistance has enabled men in the Luton works to be released to join His Majesty's forces which otherwise would not have been possible.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

ELECTRIC VEHICLES FOR SOUTH AFRICAN RAILWAYS.—The State Railway authorities have received nine electric motor lorries, constructed by the General Vehicle Company, of New York.

THE GENERAL ELECTRIC COMPANY, LIMITED, have issued an illustrated and descriptive price list of the "No-Cell" dynamo outfit for motor cars, giving headlight illumination without accumulators.

PETROL MOTORS FOR STIRLING.—The Stirling and Bridge of Allan Tramways Company propose to apply for a Provisional Order authorising the substitution of petrol tramway cars for the present horse cars.

MR. W. A. STEVENS has resigned the position of managing director of W. A. Stevens, Limited, as from May 1, and the management has been taken over under the joint directorship of Mr. Albert G. Mickleburgh and Mr. Percy Frost Smith.

SUPPLY OF DUNLOP TIRES.—It is stated on authority that although the Dunlop Rubber Company are executing large orders for Government, they have made arrangements by which the supplies of the standard sizes of their tires to the public will not be interrupted.

THE TRENT MOTOR TRACTION COMPANY has obtained a new fleet of Tilling-Stevens petrol-electric omnibuses to replace the vehicles that were commandeered by the military authorities. The new vehicles are fitted with handsome saloon-type bodies, and the complete service will shortly be again in operation.

EDISON ELECTRIC OMNIBUSES AT YORK.—At a recent meeting of the York City Council it was reported that from February 15 to March 10 inclusive the four electric omnibuses recently supplied by Edison Accumulators, Limited, had run 998·8 miles and carried 10,246 passengers. The receipts averaged 9·88d. per mile.

SCOTTISH COMMERCIAL CARS.—A new type of "Caledon" chassis has just been delivered to the Great North of Scotland Railway. These machines are fitted with a 40-H.P. engine and are of the live axle type with worm drive. A feature of this model is that the axle drive is transmitted to the wheels by spliced dogs bolted on outside and forming axle caps.

NEW ARROL-JOHNSON COMMERCIAL CHASSIS.—A new 2½-ton chassis will shortly be placed upon the market by Arrol-Johnson, Limited, of Paisley and Dumfries. This will be fitted with a 4-cylinder engine, 90 mm. bore, with 140 mm. stroke. There will be an automatic governor and ignition advance, while the lubrication will be on the forced-feed principle. Thermo-syphon water circulation is the cooling system.

MESSRS. ALLEY AND MACLELLAN'S NEW WORKS.—In order to meet the exceptional demand for all types of their well-known Sentinel steam wagons, Alley and MacLellan, Limited, of Polmadie Works, Glasgow, have found it necessary to separate the wagon business from their other departments, and have therefore decided to establish works at Shrewsbury, which will be entirely devoted to steam wagon manufacture.

A NEW 3-TON CHASSIS.—Messrs. Seabrook Brothers, of Great Eastern Street, London, E.C., have placed upon the market a 3-ton chassis which is fitted with an engine and transmission specially designed for high speeds. The chassis, which is the product of America, is claimed to be admirably suited for fire engine work and other services where speed is an important factor. The four-cylinder engine gives a normal rating of 48 H.P., but at a speed of 1,500 revolutions per minute it gives over 70 H.P.

CONSTRUCTION OF CROYDON MOTOR ROAD POSTPONED.—It has been decided that the construction of the new motor relief road between Thornton Heath and Purley, by which the narrow and congested main street through Croydon will be avoided, shall not be proceeded with until the war is over. The Road Board, however has authorised the Croydon Borough Council to acquire the necessary land and enter into agreements for the erection of new railway bridges at Epsom Road and Waddon Marsh.

MOTOR FIRE ENGINES AT NOTTINGHAM.—Mr. T. Breaks, superintendent of the Nottingham Fire Brigade, has written to Messrs. Dennis Brothers, of Guildford, in reference to the fire engines and the Dennis ambulance supplied by the company to Nottingham, as follows:—"I am pleased to inform you that the whole of the engines are giving entire satisfaction, and the ambulance continues to do valuable service. During the past year the total miles run was 1,945, the total maintenance cost was £41 6s. 10d. (less wages), or 5¼d. per mile, whilst the amount of revenue derived from private cases was £52 16s. The total number of patients removed was 503."

STRAKER-SQUIRE (1913), LIMITED, London, have received notification that their tender for a fleet of large single-deck omnibuses and a number of smaller machines has been accepted by the Metropolitan Asylums Board. This large contract was obtained in the face of the keenest competition, and after a thorough examination of the striking points of the company's 1915 design of vehicles. It can readily be understood that for machines of this sort, perfection in the silence of the gears on all speeds, and smooth springing of "the load" is a *sine qua non*, and it is considered that these essentials have been reached in the latest "Straker-Squire" productions to a most remarkable degree. The importance of the contract in question may be gauged by the fact that the London authorities deemed it advisable to obtain War Office sanction and co-operation in the placing of the contract.

ALBION MOTOR VEHICLES AT THE FRONT.—The Albion Motor Car Company, Limited, have sent us an extract from a letter which they have received from a soldier at present with one of the cavalry motor supply columns with the British Expeditionary Force, who was actively engaged in connection with the recent action at Neuve Chapelle. The writer of the letter says:—"It was indeed a terrible battle, and I shall never forget the sights I then saw. You can hardly imagine the enormous damage the German shells have effected. It was during that time that our commanding officer earned the D.S.O. During the recent fight at Neuve Chapelle only 'Albions' were used to carry the shells for the big guns. Three shells constitute very nearly a full load." The Albion vehicles to which the writer refers carry a net load of three tons, and as only three shells can be carried at a time, the huge dimensions and weight of this form of ammunition will be apparent.

COMMERCIAL CARS, LIMITED, has instituted a novel method of expressing its appreciation of the abilities of the drivers in its employ. It takes the form of presenting these drivers with a solid gold medallion, relieved on one side in blue enamel and blank on the other side for a suitably engraved inscription, to be worn on the watch chain. It is intended that this presentation shall be made to drivers from time to time when, in the opinion of the company, they have by their good record for a number of years earned some recognition. The first driver to receive one of these medallions is Mr. George Rich, who has been chief demonstration driver in the company's service for eight years. Rich's record is a very fine one, as he has to his credit the fact that he has never had an accident with a Commer car, that he has never failed to keep an appointment, and that he has never had any mechanical trouble with the different machines he has handled while demonstrating.

ELECTRIC VEHICLE COMMITTEE.

At a meeting of the Electric Vehicle Committee held in London in April, it was resolved to point out to electrical supply undertakings that the adoption of electric vehicles in their districts did not necessarily require any extension of the mains or plant. The supply was entirely an "off peak" load, and undertakings on that account should, at the present time, use every endeavour to make known the advantages of electric vehicles. Regarding those electric supply undertakings in the metropolitan area that charge more than 1d. per unit for electric supply for vehicles, the secretary reported that in accordance with the instructions of the committee he had written to them asking if they could see their way to come into line with the committee's recommended tariff of 1d. per unit. No satisfactory reply, however, had been received from any undertaking to which the letter had been addressed. It was reported that certain undertakings had found it necessary to advance prices all round, owing to the increased cost of coal, etc. It was decided that where such advance in price is only of a temporary nature, the undertaking concerned shall still have its name in the list in which it at present stands on the tariff sheet of the *Journal*. The committee have had reported to them that there are vehicles not fitted with the standard receptacle which come for charging at certain stations. The committee decided to insert a paragraph in the next issue of the *Journal* advising electric supply undertakings to do what they can to persuade the owners of such cars to have the standard receptacle fitted. The secretary was also instructed to get into touch with the American manufacturers of electric vehicles, pointing out the necessity of fitting the standard receptacle. As to the standardisation of metal filament lamps for use on electric vehicles, another meeting had taken place between representatives of the Tungsten Lamp Association and the E.V.C. Technical Sub-Committee. As a result of the report of the latter sub-committee, it was decided to adhere to the previous recommendation—i.e., that the lamps used should be for a pressure of 12 volts and in accordance with the requirements of the British Engineering Standards Specification No. 69.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

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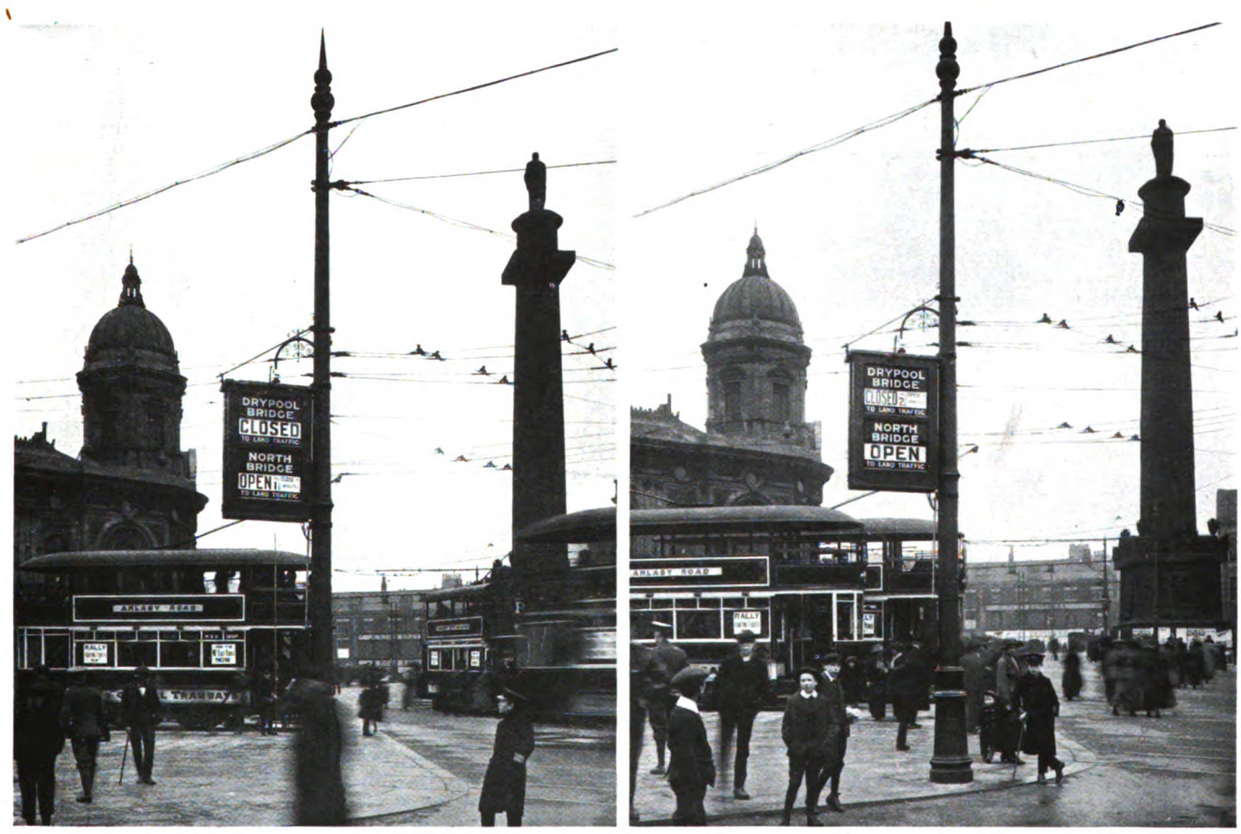
TRAFFIC SIGNALS AT KINGSTON-UPON-HULL.

LEVEL CROSSINGS AND MOVABLE BRIDGES.

On five of the tramway routes in Hull the road is traversed by railway level crossings, which cause an enormous amount of delay to the tramway traffic. Special road signals are in use, and are worked by the railway company from their signal boxes. When a car approaches a railway crossing it has a compulsory stop at a mark 25 yards from the crossing gates. A signal is placed between the mark and the gates indicating in the ordinary railway fashion whether a train may be expected or not. Catch-points are attached at this part of the road in order to prevent a car accidentally over-running the mark and colliding with the gates. The system of signalling works exceedingly well, but there is, as has been stated, a very heavy loss of time to tramway traffic.

At a point on Anlaby Road at which the Anlaby Road route and the Hessle Road route converge, and the latter is entered by a narrow street round a corner, a system of signalling in connection with the tramways is in use by which the cars going round the corner on a short piece of single line are regulated. This is one of the very short portions of single line in Hull. The signalling has proved a very satisfactory way of getting over a grave difficulty.

The long Holderness Road route, which begins at Queen Victoria Square and ends at East Park, is crossed not only by a railway, but by a movable bridge (North Bridge), which spans the River Hull. Another tramway route begins at Queen Victoria Square, crosses the Whitefriargate movable bridge, proceeds down Alfred Gelder Street, and is intercepted by Drypool movable bridge across the River Hull, parallel to the North Bridge before-mentioned. These two lines converge at a point just over a mile from the centre (Dansom Lane), and form one main route. It frequently happened that cars at North Bridge were



Tramway Indicators for the Bridges, Kingston-upon-Hull.

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blocked at tidetime by the raising of the bridge for the sake of river traffic, and the same trouble happened at Drypool Bridge, sometimes simultaneously. This caused delay of from five to fifteen minutes to passenger traffic. In order to obviate the trouble a system is in operation whereby at Queen Victoria Square, at the commencement of the double routes, and at Dansom Lane (a mile further along where the double routes converge), special electrical indicators are placed for the use of the tramway men and the public, with information as to the closing or opening of Drypool and North Bridges. A car, say, about to start from Queen Victoria Square *via* the North Bridge route is apprised before starting of the opening of that bridge, and the car therefore takes the alternative route, namely, by Drypool Bridge, and *vice versa*. The information as to the opening or closing is given in graduated detail, and the driver of the car makes his arrangements accordingly. The same course is adopted at the converging point (Dansom Lane) going towards the central terminus. Every care is taken, of course, to provide that both bridges shall not be open simultaneously. The system has been in operation a short time, and seems to meet the wishes of the public very well. Of course, there is a certain amount of inconvenience consequent upon this arrangement, as passengers who board a Drypool Bridge car going into town may be taken *via* North Bridge, and *vice versa*. But this is an inconvenience which cannot be remedied, and is imposed upon only a small minority. The Whitefriargate Bridge, before spoken of, which spans one of the docks, is opened infrequently, and is not taken into account as a cause of delay.

Having explained the traffic arrangements, some details may now be given of the bridge indicator apparatus. The installation consists of two controllers and four double indicators. The controllers consist of a multiple-contact, sector-shaped main switch, worked by a double handle on its axis, and connected by steel rods to an oil dashpot, to a cut-off switch, and to a lever carrying an adjustable counterweight. This switch has six contacts making and breaking circuit with suitable spring controlled fingers giving a quick break, the rupture of the circuit being further assisted by a magnetic blow-out arrangement.

The dashpot consists of a cylinder completely immersed in oil in a copper tank, the lower part of the cylinder having a valve regulating the admission of oil. The piston is fitted with cup leathers and has an internal foot-valve of mushroom type, permitting the easy flow of oil through the piston on the downward stroke, but closing on the upstroke, when oil can only obtain admission to the lower part of the cylinder through the regulating valve in the cylinder wall. A gauze filter is fitted so that the oil delivered over the top edge of the cylinder on each upstroke is filtered before passing to the lower part of the tank, thus avoiding the possibility of choking the regulating valve.

The cut-off switch is of drum type, operated by a loose lever connected to the main switch, which closes the circuit when the main switch handle is turned to its full extent in a clockwise direction. The cut-off switch is held in its closed position during the slow return of the main switch by a gravity-controlled detent. On the completion of the return stroke of the main switch the loose lever raises the detent and the cut-off switch opens. The counterweight is raised when the main switch is turned as above, and its weight causes the main switch to return to its original position.

In order to operate the signals prior to opening or closing a bridge, the handle of the controller is merely turned as far as it will go in a clockwise direction and released. This action raises the counterweight, forces the dashpot piston to the bottom of its cylinder, and closes the cut-off switch. As the switch slowly returns to its position under the pull exerted by the counterweight, its speed being retarded by the dashpot, successive currents are sent along the indicator lines as each pair of contacts passes the contact fingers. The circuit is closed for a few seconds five times at half-minute intervals, and once after a final interval of one minute. These intervals are determined by the spacing of the contacts of the main switch and by the regulation of the dashpot valve. As soon as the circuit is opened the release of the cut-off switch operates, thus opening the main circuit and leaving the apparatus ready for the next similar sequence of operations.

A series of three 200-volt 16 candle-power lamps is arranged inside each controller case, which lights up as long as the cut-off switch is closed, thus indicating to the attendant, first, that the apparatus is in operation; second, when the cycle is completed and the bridge may be moved. One such controller is fitted in a polished wood case in the bridge master's office at North Bridge, the other, in a cast-iron street pillar, erected on Drypool Bridge, in each case close to the hydraulic gear of the bridge in question.

Four double indicators are fixed at points where the alternative bridge routes diverge. These consist of watertight wood cases secured to the tramway poles, each accommodating an indicator for Drypool Bridge and one for North Bridge. The front of each indicator is of plate glass, the upper part of which has the name of the bridge written in white on an opaque black ground. Below this is a clear space through which a movable blind is shown, and the lower part of the panel carries the words "to land traffic" written as described above.

Each indicator has two aluminium rollers upon which is fitted a translucent blind carrying a series of wordings, which, visible through the glass and taken in connection with the fixed lettering thereon, indicate the availability or otherwise of the bridge concerned.

Normally the indicator reads ". . . Bridge OPEN to land traffic." When the controller is operated the reading changes to ". . . Bridge OPEN, will close in 3 minutes to land traffic," and so successively at half-minute intervals until "will close in 1 minute" is shown. On the expiration of one minute the indicator changes to ". . . Bridge CLOSED to land traffic," the word "Closed" being lettered red. When the bridge is again to be thrown open to land traffic a similar series of indications but substituting "Closed" and "will open" for "Open" and "will close" is shown, the blind finally running back to its original position and again showing the "OPEN" indication.

The operating gear consists of an electromagnet, the movable core of which actuates a pawl engaging with a twelve-tooth ratchet wheel, which is thus rotated through 30 degrees at each current impulse from the controller. This wheel is mounted upon a shaft, at the other end of which is fitted a gear wheel having 150 teeth, this wheel being mounted upon ball bearings on the shaft and having a pawl fitted to it through which the drive is transmitted to the wheel by a cam upon the shaft.

This wheel engages with a 25-tooth pinion fixed to the upper blind roller, so that the roller makes half a turn for each stroke of the magnet. In this way the blind is wound upon the upper roller about 7 in. for each current impulse from the controller, thus showing the various indications through the clear glass panel. The lower roller has a small drum at one end from which a cord is led to a suitable counterweight which keeps the blind taut.

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There are twelve lettered spaces upon the blind, the last of which reads "Closed, will open in 1 minute," and the twelfth current impulse from the controller, i.e., the one marking the completion of the second cycle of operations, causes the disengagement of the gear wheel pawl from the cam on the driving shaft, thus leaving the gear wheel free to revolve and return to its original position. This it does owing to the pull of the counterweight unwinding cord from the drum and rewinding the blind from the top roller to the bottom one.

In order to reduce the heating of the magnet coils and the current to be broken at the controller contacts, the magnet cores are arranged so that at the bottom of the stroke a set of three lamps in series are introduced into the circuit. The working parts of the indicators are all fitted with ball bearings, and aluminium is used where possible for the sake of lightness.

AN INTERNAL COMBUSTION SHUNTING LOCOMOTIVE.

The use for shunting purposes—or switching as it is called in America—of a locomotive with an internal combustion engine is something of a novelty, especially in this country. As it is obvious that, apart from anything else, there must be a great reduction in stand-by losses as compared with a steam shunting locomotive, we give the following description of a gasoline (or petrol) driven switching locomotive of American make, and of improved type. It is a 300 H.P. machine, and was recently purchased by the Motley County Railway, Matador, Texas, from the McKeen Motor Car Company, of Omaha, Nebraska. The locomotive made the trip from Omaha to Matador, Texas, under its own power, and is used in the vicinity of the latter in freight and switching service. This locomotive has a tractive effort of 12,000 lb. at six miles per hour. The motorman's position in the centre and on the right side of the locomotive with an uninterrupted view in all directions, together with the air reverse control, gives great facility for responding to signals. Of the general features only the cab resembles the 200 H.P. locomotives built by the McKeen Motor Car Company, the 300 H.P. design being, as will be seen from the accompanying illustration, of the 0–4–2 class.

The frames are of cast steel, and the driving wheels are 42 in. in diameter. The usual locomotive spring suspension, with equalisers, is employed. The engine bed is a steel casting forming an efficient brace and reinforcement in tying together one side frame to the other.

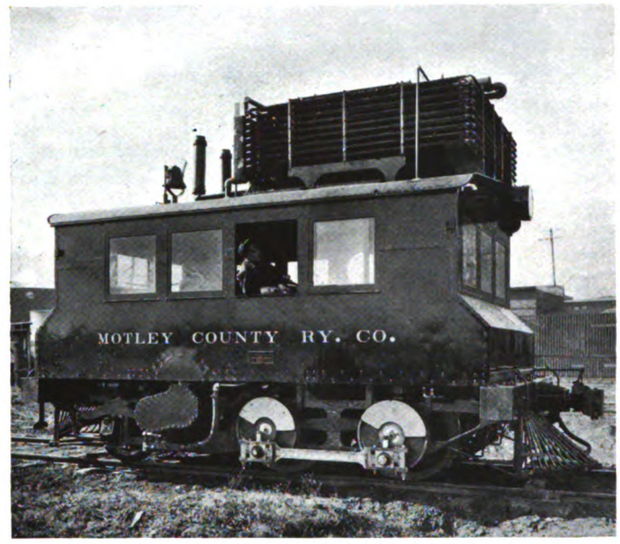
The cab, an all-steel structure, covers the entire length of the locomotive frame between the bumper beams, and is so bolted to the frames and buffer beams as to add very materially to the strength of the locomotive. All equipment, accessories, etc., in the cab are conveniently placed and do not obstruct the motorman's view in any direction. Acetylene gas is used in the headlights.

The "straight" air brake is employed on the locomotive, which has a Gregory brake valve permitting the operation of automatic brakes on the train.

The internal combustion engine has six cylinders, each with a diameter and stroke of 11 in. and 15 in. respectively. The general design and details correspond to the McKeen Motor Car Company's latest model type C engine, the efficiency, reliability and economy details claimed for which are—increased water circulation round valves and cylinder heads; Tungsten steel valves; piston triple rings; special compound hardened cams; faultless magneto; water jacketed intake pipes; enclosed fly wheel, crank case and cam shaft, water and air pumps driving mechanism; combination splash and automatic lubricating system, and all gears of the herringbone type.

Among the new characteristics is the use of two exhaust pipes, which extend through and above the roof. The engine is equipped with an air reversing mechanism, which adds materially to the convenience and ease of the motorman. Two 5 in. air compressors are attached to the engine crank shaft; in addition there is an auxiliary air compressor in the cab for emergency service.

The ends of the front or main driving axle and the rear driving axle have counterbalance crank discs, which are connected by side rods. The power transmission, pneumatically controlled, is effected by means of a sprocket on the crank shaft through a Morse chain to a sleeve working free on the rear driving axle, and is then transferred through a multiple-disc friction clutch, from which it is delivered by a Morse chain to the forward driving axle where, by an octoroon clutch, the power is either modified by a series of gears



Internal Combustion Shunting Locomotive.

to produce heavy tractive effort and high torque for starting purposes, or is delivered direct to the driving wheels. By thus increasing the torque of the internal combustion engine, great starting effort is obtained for this style of locomotive. At the same time the locomotive once in motion, higher economy is obtained by cutting out the gears and operating the direct connection. This is a very simple mechanism, the motorman's control of which is much more convenient than in the case of steam locomotives.

The following are general dimensions:—

Gauge	4 ft. 8½ in.
Driving wheels, diameter	3 ft. 6 in.
Driving wheel base	4 ft. 8 in.
Total rigid wheel base	12 ft. 0 in.
Length over bumper beams	19 ft. 6 in.
Length between pulling faces of couplers	22 ft. 5½ in.
Length over all	22 ft. 11⅝ in.
Height, rail to top of exhaust pipe	13 ft. 3 in.
Height, rail to top of cab	10 ft. 8 in.
Width over cab	9 ft. 8 in.
Width over cab eaves	10 ft. 0 in.
Centre to centre of frames	6 ft. 9¼ in.

A steam shunting locomotive in many ways is an expensive luxury. It has the expense of coal, water, sand, roundhouse, and turntable service, the engine crew, ground crew, and while standing the consumption of coal and water goes on, for the boiler must be kept

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hot. In fact, in many instances the engine is kept in serviceable condition 24 hours out of the day and frequently only used four or five hours. In the case of the petrol shunting locomotive, however, the cost of operation is in direct ratio to the daily time of service. Its availability for the 24 hours would not cost any more than its availability for six hours. In fact, petrol shunting service in small yards and at local points, etc., could be put on an efficiency basis, so that the cost per unit would very favourably compare with the cost of larger units in large termini, where the shunting service is operated 24 hours of the day. In other words, at many local stations where the shunting is now done by regular goods engines it can be economically and expeditiously handled by the gasoline switching locomotive.

BRIDGES OF REINFORCED CONCRETE.

The uses to which, until recently, reinforced concrete has been put by modern engineers and builders are many, but hitherto the material has been regarded chiefly as a foundation. Houses have been built of solid concrete in this country, but the walls of those structures are so thick as to suggest that the builders have not had full confidence in the cohesive stability of the material. It has been left to our Continental neighbours to demonstrate the latter quality of concrete, and they have achieved the purpose in magnificent style. On the page opposite we show illustrations of two splendid bridges, both built of solid concrete. The one is the "Pont del Risorgimento ou de la Renaissance," which spans the Tiber in Rome, and is by far the largest bridge of the kind in the world. Completed in 1912, the bridge excited the admiration of visitors to the International Exhibition. Some people have imagined that the structure was merely a sort of side show of the Exhibition, and rather an exhibit than a serious piece of architecture. But the great structure still stands in all its strength and beauty, bearing the traffic of tramways, motors, and all other conveyances, with all the stability and security which the strongest of bridges could show. On this account the bridge has become an object of respectful curiosity to tourists in Rome, and the subject of professional interest to civil engineers and bridge builders from all parts of the world.

For more than a quarter of a century Messrs. Hennibique, the builders of the bridge, have been acquiring a reputation throughout the world for the strength, elegance, and usefulness of the buildings they have erected in concrete, and the Roman bridge is the latest and greatest of their works. The bridge spans the Tiber in a single arch of 100 metres in length, with a curve of 1 in 10. Simple almost to severity, gigantic yet elegant, the design presents an aspect of great boldness. In constructing the work, Messrs. Hennibique encountered serious difficulties; they had to find adequate support for piers bearing a weight of 16 million kilogrammes in the alluvial soil of the Tiber, which is loose, spongy, and unstable. Owing to the unstable nature of the subsoil, all the bridges and quays in Rome are founded on wooden piles. Messrs. Hennibique, however, adopted a plan by which the whole structure could be made homogeneous. First, on each bank of the Tiber they introduced mechanical compression of the subsoil, and then on the hardened and hollowed surface built 95 piers of hard concrete, which were formed into a solid block. The compression reduced the surface about 26 ft. 6 in. on an extent of 600 metres, and therefore each block of concrete piers amounted to 4,800 cubic metres in dimensions. Upon these buttresses the piers of the bridge on both sides of the Tiber were based. Having formed a foundation so secure, the bridge builders constructed the wide and graceful arch, which, after tests of the most severe character, demonstrated its stability.

The second picture is that of another concrete bridge, rather different in character, which carries an electric railway across the Reuss at Bremgarten, Switzerland. This also is a fine example of solid concrete. As may be observed, the bridge is constructed to encounter floods, the piers being hollow arches. That such a bridge should have been constructed shows the confidence of its builders in concrete as a building material.

TRAMWAYS AS AN INDUSTRIAL ASSET.

The use of a conveyance for travelling short distances was at one time regarded as the necessity of the wealthy, the luxury of the middle class, and the extravagance of working people. One of the obstacles which the pioneers of tramway enterprise had to overcome was the prejudice in the mind of the ordinary man and woman against using any other conveyance than "shanks pony" for travelling distances within the confines of their own parish or township. The early patrons of tramways were mostly of the middle classes, and tramway rides appeared to the mind of the workman as an indulgence for holidays. Nor did the well-dressed patrons of the cars welcome the artisan in working garb in their midst. Fortunately for tramway enterprise, the views of working people gradually changed, and they have come to regard tramways as an ordinary convenience in every-day life. This, of course, was partly brought about by reductions in fares. Workmen found that a penny ride from home to the workshop or factory was worth more to them than it cost; they could have longer rest in the mornings, and arrived at work fresher and abler for duty.

Public ownership removed part of the working-class prejudice against the use of tramways, and the tendency is now to the opposite extreme; the masses are coming to look upon the tramways as common property which they are entitled to use at the smallest cost to themselves. The desire of the working people to exploit the ratepayers through the tramways has introduced a sinister element into municipal life which ought to be opposed in the interests of the workers themselves. Rates are paid by the commerce and industry of the community, and high rates inevitably react on wages in the long run, either in the form of higher prices for goods or reduced employment. But the view that tramways are largely a public utility shows how deeply they have entered into the life of the community. Large numbers of workmen in every industrial locality count tramway fares among their necessary expenses, like boots or tools or house rent. It is a commonplace of tramway management that where an industrial concern employing large numbers of workmen is placed, there additional cars must be run at hours suitable for the workers. Workmen's fares and workmen's cars are included in the provisions of every tramway service. One of the most potent arguments in favour of a Parliamentary Bill authorising extensions is that it will serve the needs of the industrial community.

Another aspect of the subject comes in sight when we view the effects of the tramways themselves upon the distribution of the population. The residential areas from which labour can be drawn have been extended by the tramways. Secure in the knowledge that he can get a car to take him to his work, the artisan may choose to live in a locality removed a mile

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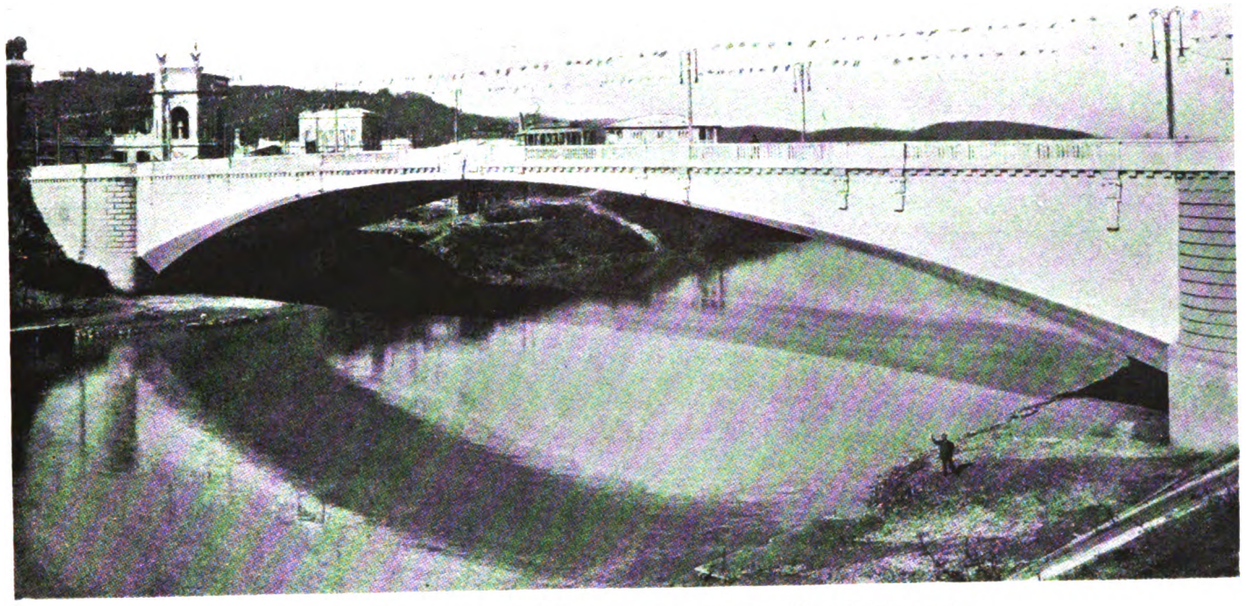
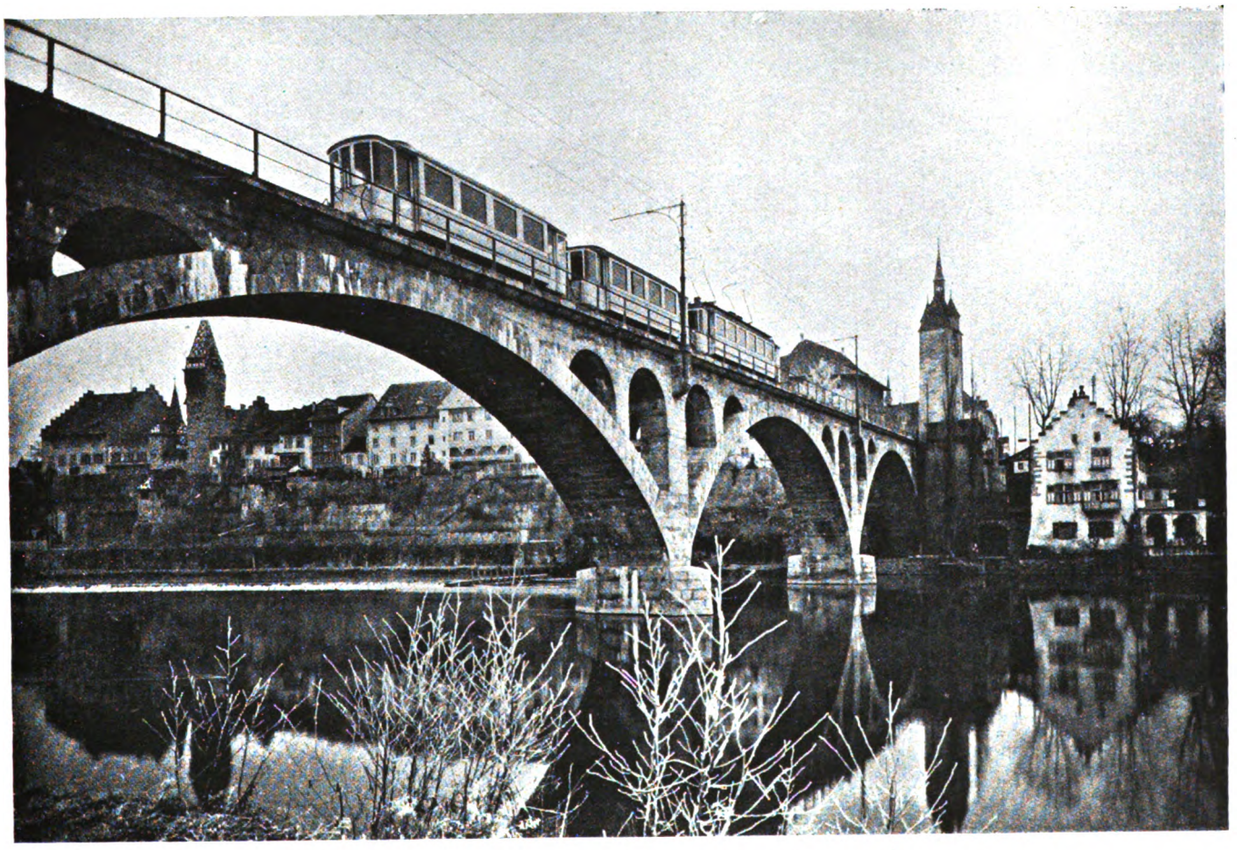


Concrete Bridge over the Tiber at Rome carrying Electric Tramways.



Electric Railway Bridge of Concrete over the Reuss.

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or two from the smoke and grime of his employment. With the laudable desire to bring up their children in pleasant and healthy surroundings away from the crowded hives of industry, workmen seek residences outside the towns, if a tramway service is available. Populous suburbs have been built in dependence on the tramways, and without them they could not exist. In a hundred different ways tramways have moulded the life of industry; they are the channels of industrial power, cheap, effective, and immediately useful. One has only to try to imagine what would be the effect upon the industry of the country if all the tramways were to be suddenly stopped. Not long ago by the bursting of a flywheel in a power station, the industrial activity of Cardiff, a city of comparatively short distances, was thrown out of gear. The strike of London tramway workers became a matter of grave concern to the nation, because stoppage of the tramway service involved the labour supply at Woolwich Arsenal. Suspend the route between Bury and Rochdale, and you stop the wheels of a hundred mills. Manchester, Glasgow, Leeds, Bradford, Birmingham, Liverpool, Hull, and many other industrial centres have become so utterly dependent upon the tramways that they could not exist as they do without them. By the tramways the lives of the workers have been economised both in time and in vital energy; the wheels of industrial production have been quickened. Viewed in the aggregate, the sums spent upon tramways seem enormous, but the money has been well spent and returns a profit in industrial value alone. That is to say, tramways serve also the health and comfort of the nation, and might be valued on that ground; but even if the whole cost of the service were charged against its return to industry, the result would show a high rate of profit. The economic gain can hardly be stated in figures, but that tramways are an asset of great value to industry is amply proved by everyday experience.

GLASGOW TRAMWAYS DEPRECIATION.

Owing to the financial difficulties caused by the present crisis, the Finance Sub-Committee of the Tramways Committee of Glasgow Corporation instructed the general manager, Mr. James Dalrymple, to prepare a statement on the question of reduced depreciation allowances, which was submitted to the Tramways Committee meeting on May 11. It was agreed to recommend that allowances for depreciation be made in the accounts for the current financial year as follow:—Permanent way, £350 per mile, as compared with £440 last year; electric equipment of line, average 2·9 per cent., as against 4·3; buildings and fixtures, 2½ per cent., being the same as last year; power station and sub-stations' plant, 5 per cent., as against 7·1; workshop tools and sundry plant, 5 per cent., as against 7½; cars, average 8·2 per cent., as against 9½; electric equipment of cars, 6 per cent., as against 7½; other rolling stock, average 16·4 per cent., being the same as last year; and miscellaneous equipment, 5 per cent., as against 7½.

The Expense of Local Tramway Differences.—Speaking at Elland District Council meeting on May 5, in reference to the opposition of Huddersfield Town Council to the Halifax Corporation Bill, which resulted in the dropping of the clauses in the latter relating to the projected Elland tramway, Mr. S. Lund, chairman of the Elland District Council, said that if the two boroughs could agree, no Parliamentary Committee could stand in their way, and he would not be surprised if the promoters and opposers of the Bill had spent between them from £3,000 to £4,000. What an expensive way of settling local differences.

THE OWNERSHIP OF RUSSIAN TRAMWAYS.

German Financial Interests.

Owing to lack of funds Russian municipalities were, until recently, not able to finance large undertakings of public utility, such as electric tramways. Consequently private contractors of foreign nationality obtained a strong footing in Russia as concessionaires of such concerns. Although it has not generally been known, the Germans are deeply interested financially in Russian tramways; and as will be seen further on the preponderance of Belgians in the control of Russian tramways is largely nominal only. For various reasons largely referable to political considerations, Germans in the 'nineties had recourse to a certain international subterfuge in order to establish themselves firmly in the Russian tramway systems. They organised a large number of financial concerns in Belgium which operated in Russia under the Belgian flag, and secured a large holding in the tramway concerns, which according to a Petrograd publication have hitherto been considered, though in error, as exclusively Belgian, for a close examination will show them to be in fact controlled by Germans.

The statement to which we have referred says also that the formation of German financial companies in Belgium synchronised with the initiation in Russia of Belgian tramway enterprise. This was by no means a simple coincidence. Belgian tramways in Russia are the result of the preliminary operations of German financial companies. In order better to follow the complicated system of the Russo-Belgian tramway concerns financed by Germans, the following circumstances should be noted:—In the year 1895 German banks, along with strong industrial groups, established the financial syndicate in Brussels called the "Société Générale Belge d'Entreprises Electriques," followed in 1898 by the "Société Financière de Transports et d'Entreprises Industrielles," and in 1911 by the "Tramways et Electricité en Russie." Between 1895 and 1898 the Germans established in Brussels two financial syndicates to finance electrical and tramway concerns. This was done just when the Russian towns developed a large number of new tramway systems. During the period named ten new Russo-Belgian tramway concerns were formed, namely, three in 1895, three in 1896, three in 1897, and one in 1898. And the said German financial syndicates further succeeded in obtaining during that period a considerable portion of those Russo-Belgian tramway undertakings that were formed in the 'eighties of the last century. The following is a list of the tramway concerns in Russia mostly controlled at the outbreak of the war by the combination referred to above, the years following the respective titles being those in which they were established:—

Odessa Horse Tramways Company (1880), Karkoff Horse Tramways Company (1883), Tiflis Horse Tramways Company (1885), Warsaw Horse Tramways Company (1882), Moscow Horse Tramways Company (1885), Rostoff-on-the-Don Horse Tramways Company (1886), Kazan Horse Tramways Company (1893), Bielostok Horse Tramways Company (1895), Kishineff Horse Tramways Company (1895), Kursk Tramways Company (1895), Astrachan Railroads Company (1895), Orel Tramways Company (1896), Vitebsk Tramways Company (1896), Tramways & Electrical Uses Company (1897), Ekaterinoslaff Tramways Company (1897), Tashkent Tramways Company (1897), Reval Tramways Company (1898), Vladikavkaz Electrical Tramways and Lighting Company (1900), Saratoff Tramways and Lighting Company (1905), Kieff Tramways Company

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(1905), Riga Tramways Company (1903), and Simferopol Tramways Company (1911).

The tramway concerns enumerated in the foregoing list may be divided into five groups: (1) The tramways of Odessa, Tiflis, Moscow, Bielostok, Riga, Simferopol, and Ekaterinoslaff. These are almost exclusively under German control. (2) Kursk, Kazan, Orel, Saratoff, Kief, and Rostoff. These are controlled by the "Compagnie Mutuelle de Tramways," which is in intimate relation with other German-Belgian financial syndicates. (3) The Tramways and Electricity Company, and the Reval Tramways. Both these concerns are mainly governed by G. K. Schodwar, who amongst other things is chairman of the board of the Russian Pipe Rolling Factories, in which Germans are interested—particularly the Deutsche Bank and the Commerz und Discontobank. (4) The Kishineff, Astrachan, and Tashkent Tramways. All these are in the hands of E.L.I. Empaint. Whether the Germans have managed to establish financial contact with this independent group is not definitely known. (5) The Karkoff, Warsaw, Vitebsk, and Vladikavkaz Tramways. In these only French and Belgian capitalists are interested.

If we distinguish these five groups by their original capital and debentures, the following table results:—

	No. of Concerns.	Capital.	Debentures.
Group 1 ...	6 ...	38,970,000 francs ...	49,790,000 francs
,, 2 ...	6 ...	29,190,000 ,, ...	35,150,000 ,,
,, 3 ...	2 ...	11,200,000 ,, ...	6,460,000 ,,
,, 4 ...	3 ...	7,340,000 ,, ...	5,770,000 ,,
,, 5 ...	3 ...	5,460,000 ,, ...	1,660,000 ,,

The Moscow tramways in Group 1 and the Warsaw tramways in Group 5 have been bought up by the respective municipalities.

As can be seen, the most powerfully capitalised group, namely, No. 1, is the one controlled by German banks and syndicates. Group No. 3 is mostly under German control, and Group No. 2 is largely influenced by German financial interests. Germans in one way or another are interested in 14 Russo-Belgian tramway concerns operating in Russia with a total original capital of 79,360,000 francs, and a debenture debt of 91,400,000 francs, whereas Belgians and French control only six concerns, with an original capital of 12,800,000 francs and debentures—7,430,000 francs. True, in 1912 a Franco-Belgian group formed a new share company in Belgium, called the "Tramways et Entreprises Électriques de la Banlieue de St. Petersburg," which is financed by the Oranienbaum Electric Railway Company, in which the Petrograd Private Commercial Bank is closely interested.

Of the above-named three German financial syndicates in Belgium, the ones mostly interested in Russian concerns are the "Société Financière de Transport et d'Entreprises Industrielles" and the "Tramways et Electricité en Russie." This last syndicate controls the following concerns:—The Riga Tramways, the Odessa Telephones, the Bielostock Electric Lighting Company, the Radom Electric Lighting Company, and the Simferopol Electric Lighting Company.

The financial syndicate called the "Société de Transports et d'Entreprises Industrielles" controls the Odessa horse tramways, the capital of which is 22,000,000, francs with debentures 27,860,000 francs, and the Odessa Electrical Company, capital 8,000,000 francs: that is to say that German capital controls the Odessa tramways, telephones, and lighting. This same syndicate is one of the powerful German financial concerns in Belgium. Its head is the director of the Deutsche Bank, Dresdner Bank, Disconto Gesellshaft für Elektrische Unternehmen, etc. It controls 24 tramway and electrical concerns in various parts of the world. In 1907 it paid in dividend 35 francs per 500 francs share, advancing steadily to 55 francs in 1912. The Odessa properties it controls have been remarkably successful of recent years. Another of the companies named the "Tramways et Electricité en Russie" has likewise been very prosperous, and its holding, the Simferopol tramways, has also been very successful. And the series of tramways, etc., held by the "Compagnie Mutuelle" also shows satisfactory progress. The duration of the concessions obtained by Germans from Russian towns is of considerable length: for example, Kursk tramways runs from 1895 to 1944; Kazan (first system), 1893 to 1925; Odessa, 1879 to 1935; Rostoff, 1886 to 1939; Orel, 1896 to 1936; Riga, 1896 to 1936; Kieff, 1889 to 1934; Kazan (second system), 1898 to 1942.

German industrial houses hold tramway concessions in nearly all important Russian centres, and where these have not yet been used, it is simply because the propitious moment has not arrived for taking advantage of the situation.

TRAMWAY MUNICIPALISATION IN AMERICA.

The idea of municipal ownership of tramways has become a mere commonplace in Great Britain, though men still in their prime can remember when it was a novelty almost Utopian, and savouring of Socialism and other heresies against the established order. So rapid has been the change that tramway systems owned by companies are in a minority amongst us. In America, the original home of the tramway, or street railway as it is called there, the enterprise has grown great on quite different lines. Municipal ownership of tramways is still a rare exception, but during the past few years a few of the municipalities of the United States have purchased the tramways within their boundaries, and have taken up the idea with characteristic energy. The method of tramway acquisition by the local authorities in the United States bears a strong resemblance to that practised in this country, but with such differences as excite interest. At the present time the city authorities of Detroit, Michigan, are intent on purchasing from the Detroit United Railways Company the tramways within the "one-fare zone," which is equivalent to the city boundary. A specially appointed body, named the Street Railways Commissioners, roughly approximating to our own Corporation Tramway Committees, had originally made an offer of $24,900,000, or about £4,500,000 sterling, in exchange for the lines of the company within the one-fare zone, but this offer, after being declined by the company, was reduced by the city authorities to about £500,000 less. For some weeks there was a deadlock between the parties, though neither was altogether willing to break off negotiations finally. After a few informal preliminaries a new plan was devised, which now seems likely to issue in a bargain being made.

The plan proposed is that the price of the lines shall be fixed by the circuit judges of the County Court, sitting as a Court of Arbitration, with a right to appeal to the State Supreme Court by either party in the event of dissatisfaction with the award. To accomplish this plan, the Street Railway Commission of Detroit propose the submission of the question of municipal ownership of the tramway lines to the electors, with the amount to be paid left blank on the ballot papers, the purchase price to be filled in later in accordance with the determination of the circuit judges. A three-fifths majority is required before the plan can go through.

The president of the Detroit United Railways Company, in a letter to the Commission declining the latter's second offer, stated:—"The price so proposed is so much less than the value of the property involved that the board cannot recommend acceptance of such amended proposal to the stockholders. The board reaffirms its willingness to sell this property at the price offered by the Street Railway Commission in its original proposal under date February 23, 1915—viz., $24,900,000, notwithstanding that it regards the price as inadequate."

Upon receipt of this letter, which followed an adjourned meeting of the company's shareholders, held on April 28, the Detroit Street Railway Commission called the president and general manager of the company into conference, with the result that the idea of having the price fixed by the circuit judges was tentatively accepted by both parties.

It is arranged to have the attorneys for the city start immediately upon the draft of a contract which will be the basis of further negotiations between the United Railway Company and the Detroit Street Railway Commission. It will be seen that though the method of purchase by arbitration of tramways by municipal authorities in the United States differs in detail from that followed in this country, the principle is at bottom the same.

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Tramways as War Servants.

Apart from the acute phases of the labour difficulty which have recently made their appearance, the tramway industry has suffered to a peculiar degree from the effect of the war upon the supply of men. Drivers and conductors are generally of military age, except in certain districts where conductors in particular are recruited largely from the older men employed in other municipal departments. Moreover, a considerable proportion have been through military or naval service, and on the outbreak of war they rejoined the colours. As a rule, they were the best men from the tramway manager's point of view. Military discipline not only makes men more reliable and more accurate, but it gives them a superior sense of responsibility, and makes them more efficient in almost every detail of their work. It has been found, for instance, that the uniforms of ex-soldiers last much longer in good condition than those of men who have never been trained to look after their clothes according to a fixed routine. The loss of such men is in itself a serious handicap to a tramway service; and in addition we have the notorious fact that the first men to enlist were the most active and capable. The tendency, therefore, has been for both the quantity and quality of tramway labour to deteriorate since the war. Each wave of recruiting makes the condition of affairs more difficult for the manager who wants to maintain an adequate service; and he has also had to meet the competition of the ammunition factories. Motormen and conductors who hear of the large sums earned by partly skilled men in work engaged in Government contracts are not likely to feel more contented with the hours and wages of tramway employment, nor are they likely to welcome any measures for speeding-up the schedules or otherwise increasing the service with a restricted number of cars. Here we touch upon some of the factors which have aggravated the tendency to unrest among tramway workers. The immediate point of interest, however, is the helplessness of the tramway manager in face of the continued depletion of his staff. The employment of women as conductors is a partial remedy, but it has been violently opposed by the men, and it does not solve the main problem of maintaining a public service. Electric supply undertakings are provided with Government authority in holding certain men back from enlistment on the ground that electricity is essential to the lighting and driving of factories engaged on war contracts. No recognition has been given to the claim that tramway undertakings also perform a vital service to these factories. Nevertheless the strike on the routes leading to Woolwich and Enfield provided a sharp reminder of the value of tramways in relation to the war. In view of the difficulties crowding upon them, tramway managers would welcome a privilege similar to that enjoyed by the managers of supply undertakings. As things are, there is nothing to prevent the leakage of men to such an extent that the tramways will be unable to carry out their main purpose of transporting factory hands between their homes and their work.

Canvassing for Employees.

All over the country the difficulty caused by the scarcity of labour is being felt in an increasing degree as more and more men join the Forces. Every effort is being made by modifying organisation and duties to make the labour of the men still available as efficient and far-reaching as possible. In the classes of work in which women can be usefully employed they are being quickly

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introduced; as the number of women willing to take on work hitherto done by men is large, their services are proving of great value. In the sphere of tramways women are already to a considerable extent being employed as car conductors, and there seems to be no cause why they should not be still more largely employed in that capacity except the unreasonable objections of trade unions. Yet at a comparatively early stage of the war it was clearly announced by the representatives of labour in the House of Commons that various trade union rules and restrictions would be relaxed during the period of the war. Women are not, however, adapted to employment as car drivers, and more men are needed for this work, as well as for conductors where objections to female labour are upheld. There are different ways of getting labour for tramway undertakings, and one, of which an instance has come to our knowledge within the last few days, is certainly highly objectionable. Omitting names, the facts of which we are assured are that a man has recently visited several towns in Lancashire stating that he came from a certain corporation and offering the tramway drivers and conductors slightly higher wages than they were receiving if they would leave and engage themselves with the corporation which he professed to represent. He also offered a guarantee of three years' work. One of the tramway managers who was aggrieved by this attempt to filch away his men wrote to the tramway manager of the corporation which was alleged to have adopted the objectionable course. The reply received contained a denial that there had been any canvassing on behalf of the corporation in the district of the aggrieved manager, and a statement that when the corporation in question requires men the tramway manager instructs the labour exchanges to get them. Here, then, may be the explanation of the case. It is surely an unusual proceeding to "instruct" a labour exchange to get men. The labour exchanges are carried on under the auspices of the Board of Trade, and their business is to register men who are out of work, and to act as agent between those men and employers who want men. As we understand it, the labour exchanges are not agencies for tempting men away from existing employment in order to supply them to other employers. If anything of that sort is being done in these days of scarcity, the sooner it is stopped the better. If one tramway authority wants to get men from another, the proper course is to make regular application, and if men can be spared the matter can be arranged. What would be thought if one British railway company were to employ an agent to tempt men away from another? The thing is unthinkable. There is a similar honour among the mass of British tramway authorities, and we cannot but think that in the case here referred to there has been unwarrantable action on the part of some labour exchange.

Should Fares Be Raised?

Some interesting considerations rise from a resolution passed at a conference of managers of tramway undertakings within the Metropolitan area on May 7, to the effect "that tramways revenue cannot be improved by increasing fares generally." The assertion is opposed to experience elsewhere, for several provincial tramway undertakings may be named where revenue has been increased by the raising of fares, besides those undertakings which have abolished halfpenny fares in order to retrieve serious losses. Although the London managers' resolution does not give the information, it is evident that it is the effect of omnibus competition which led them to place that view on record in a three-clause resolution, and to send it to the Metropolitan municipal tramway authorities for endorsement. The second clause states "that joint action should be taken by the tramway authorities in the Metropolitan area to obtain more equitable treatment for tramways in respect to rates and the upkeep of roads," while a third clause affirms "that powers should be obtained jointly to run omnibus services." If the condition of unlimited competition which prevailed prior to the war was still in existence, there would be something to say in support of the managers' view, but the present circumstances are different. Long before competition reached its keenest point the owners of the omnibuses were ready to adopt working agreements with tramway authorities. A reduction of fares in the form of return tickets at a lower rate has enabled one or two tramway undertakings to recover much lost traffic, while the appropriation of omnibuses for military

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work has, for a time at least, lessened the fierceness of the competition. These circumstances are favourable to an approach being made to the omnibus undertakings for a cessation of the rivalry in so far as it is affected by reduced fares. There are also reasons which justify a raising of the fares to their former figures, apart from any consideration of what action the omnibuses may or may not be prepared to take. These considerations include the increased cost of coal, the enhanced charge for labour, and to the payment of war bonuses to the remaining employees to meet the increased cost of living, as well as a rise in pay which may accrue to the London County Council tramwaymen when their new demands come before the Conciliation Board a few weeks hence. Other considerations that call for increased revenue for the London tramways are the higher cost of working due to the wastage of electrical energy through the inexperience of the many new motormen, and the loss occasioned by the strike of the car hands. It is satisfactory to note that the Highways Committee are prepared to consider the advisability of raising workmen's fares, which are now absurdly low, and of abolishing halfpenny fares, rather than allow the undertaking to become a charge on the ratepayers, the majority of whom have no war bonuses. It is to be hoped that the Committee will lose no time in formulating a recommendation for a revision of the fares; for such a step has already been taken by the Birmingham Committee, whose proposals involve the addition of a halfpenny to every fare stage, with a halfpenny extra on workmen's tickets, which are not issued at the unprofitable charge prevalent on the London County Council system. At a time of national peril it is the duty of everyone to act as a patriot. In the words of the Bournemouth members of the Tramways and Vehicle Workers' Union, each person should, as far as possible, bear a share of the privations existing. Acting up to this profession, the Bournemouth tramwaymen have refused to "take advantage of the present crisis and position" to ask for increased remuneration.

Pleasure Traffic.

Various causes arising from the war render the present summer peculiarly suitable for encouraging pleasure traffic on tramways and motor omnibuses. The most ardent advocate of accelerating the preparation of men and material for the prosecution of the war will not contend that it is desirable for non-combatants, munition workers, and the troops in training always to have their minds concentrated on the great task confronting them. Suitable recreation is a necessity if the mind is to be kept free from despondency, and one of the best methods for attaining that end is the change of environment. Exceedingly long hours are being worked by men and women engaged in the manufacture of munitions, and by those occupied in shipbuilding. In many cases they are also working on Sundays. The risk that these people run of becoming so fatigued that they are tempted to spend in an unwise manner the little leisure they obtain affords an opportunity for tramway managers to bring before them the advantages of their services to pleasure resorts on their systems. Other potent arguments are that many classes of workers are now in receipt of more funds than they are accustomed to have in peace time, and that the railway companies have withdrawn excursion facilities. That pleasure traffic can be obtained in increased volume is shown by the record number of passengers reported from many tramway undertakings during the Whitsun holidays. The experience of the London General Omnibus Company affords proof that the best way to induce week-end traffic is by advertising. Announcements relating to these journeys, which in some cases extend to nearly forty miles from the centre of London, now find their way into local as well as daily newspapers. These advertisements are as indispensable as the maps and travel leaflets which ought to find a place in every car or omnibus and other public places.

TRAMWAY FARES AND ROAD MAINTENANCE.

Suggested Joint Action of Metropolitan Tramway Authorities.

At a meeting of Croydon Borough Council, held on May 17, the Tramways Committee submitted the following resolutions passed at a conference of the managers of the tramways undertakings within the Metropolitan area, held on May 7: (1) "That tramways revenue cannot be improved by increasing fares generally; (2) That joint action should be taken by tramways authorities in the Metropolitan area to obtain more equitable treatment for tramways in respect of rates and the upkeep of roads; (3) That powers should be obtained jointly to run omnibus services."

The Council adopted the recommendation of the Tramways Committee that the Council approve the foregoing resolutions, and that the tramways managers be informed accordingly. The resolutions were approved.

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Dr. F. S. PEARSON.

The tragic death of Dr. F. S. Pearson through the sinking of the *Lusitania* will have been noted with great regret by the readers of this journal, since his connection with the tramway and railway world was as well-known as was his connection with hydraulic and power installations.

Dr. Pearson's name first came into prominence in connection with the design of various power stations for the West End Street Railway of Boston, Mass., U.S.A. This was really the first modern traction power installation, and the power station designed by him was, at the time of its design, unique both in size and arrangements. Dr. Pearson had had an extended experience in marine engineering, and although the station would not now be considered a novelty, at that time there were very few engineers who had the insight and strength of character to launch such a bold undertaking. The first station was designed before the days of large direct-connected railway generators, but was later converted into a station making use of apparatus of this type.

Later, Dr. Pearson designed the Kent Avenue Station in Brooklyn, which was followed by the Ninety-Sixth Street Station of the Metropolitan Street Railway of New York. All these stations showed originality in design and a thorough grasp of engineering principles, together with a great foresight in comprehending in the arrangements what electric traction installations have since grown to.

The Late Dr. F. S. Pearson.

It will be recollected by those who have followed the history of electric tramways that the conduit system had been tried in a number of American cities, but with indifferent success, principally because the engineers had not taken a broad enough view of the problem, and financiers had not sufficient confidence in electric traction to spend such large amounts as were involved in making the conduit system a commercial success. Later on, the conduit became a necessary feature if the Metropolitan Railway of New York were to assume important proportions, and the work was entrusted to Dr. Pearson. According to the then views, the amount of money spent on the construction of these conduits was nothing short of colossal. Dr. Pearson's methods, however, were comprehensive and thorough, and he had the full confidence of the financiers. The result was that conduits became a commercial success for the first time in New York under his supervision. Practically all the conduits that have since been built are based on the New York design.

Subsequently Dr. Pearson became largely interested in power transmission in Mexico and Brazil. The Necaxa transmission is well known, and was carried out with Dr. Pearson's usual boldness and skill. In the course of time he arranged the consolidation in the City of Mexico of the tramways, lighting, and power, and all of these installations were a commercial success until the breaking out of the Mexican revolutionary chaos. Much the same applies to the course adopted in the case of the Brazilian Traction Company, which was also an engineering and financial success.

Amongst his many accomplishments, Dr. Pearson was an authority on iron and steel manufacture, and was largely responsible for the design of the plant of the Dominion Steel Company.

More recently he became identified with the Barcelona Traction, Light and Power Company, Limited. At the time of his death a hydro-electric installation of some 100,000 H.P. was in a partial state of completion. Before the breaking out of the war Dr. Pearson had arranged for the financing of this hydro-electric power installation, which, when completed, will be one of the largest in the world.

Dr. and Mrs. Pearson were returning to England on the *Lusitania*, and came to their untimely death through the torpedoing of that vessel by the Germans. Neither bore any ill-will towards the Germans; in fact, Dr. Pearson had in many cases used apparatus made by German manufacturers, and, in many instances, as in Mexico and Barcelona, had had extensive financial transactions with them. By their murderous methods, therefore, the Germans have removed one from whose labours they had profited largely.

Dr. Pearson, who leaves two sons and a daughter, was respected and admired by all who knew him. His friends were many, and he will be sincerely missed by those with whom he was associated, not only on account of his fine personality and sympathetic nature, but also on account of his masterful genius in dealing with engineering problems.

New Underground Station.—The new station of the London Underground Railways in Elgin Avenue, to be known as Maida Vale, was opened for traffic on June 6, thus completing the extension of the Bakerloo Line from Paddington to Queen's Park. The new station is just off the Edgware Road, in a district which has hitherto been deficient in direct railway connection with the West End and City, a disadvantage which has now been removed by the two and a half minutes' service of the Underground. From Maida Vale to Piccadilly Circus the fare will be 2d., while 3d. will be charged to Waterloo. In addition to the frequent services to town and to Queen's Park, the Bakerloo trains will run every 15 minutes to Willesden Junction, where there is platform exchange with the North Western Railway services to Pinner, Watford, and other residential districts traversed by the lines of the latter company.

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TRAMWAY STRIKE IN LONDON.

FAILURE OF THE EFFORT.

On Friday, May 14, a strike of drivers and conductors on the London County Council Tramways began at the New Cross depot in the south-east of London, and in two days it had become general over the whole system. Later many of the men employed on the Middlesex Tramways came out on strike "in sympathy." The strike began without notice and in defiance of the Conciliation Board agreement, which does not expire until June 26. By May 17 the stoppage of cars was complete, except services to and from Woolwich Arsenal, which were run by inspectors and regulators. Though every effort was made to maintain these services so as not to interfere with the work of the 40,000 men engaged in the production of munitions of war, much trouble and delay arose. The total number of men on strike was about 6,500.

The inconvenience to the public was enormous. The omnibus services were, of course, quite inadequate, and the underground and other local railways crowded to excess in the mornings and evenings. People of sufficient means used cabs largely to get to and from business, but the poorer classes were hardly hit. Where railways were not available they had to lose much time in long walks to and from their work.

The whole of the circumstances connected with the strike up till May 27 were presented to a meeting on that day of the London County Council, in the shape of a long report by the Highways Committee. In this it was pointed out that last June an agreement as to wages had been come to for a year. In February last a request was received from the Amalgamated Association of Tramway and Vehicle Workers asking for an advance in wages of 15 per cent. to meet the increased cost of living. On March 16 the Council decided that men earning less than 30s. a week should be granted an allowance of 3s. a week. The Amalgamated Association still pressed for 15 per cent. increase for all traffic employees, and they were informed in reply that no departure from the terms of the agreement under the conciliation scheme could be accepted by the Council. This position was adhered to and the strike began on May 14 without notice. Besides the demand for more wages, the men complained of long spread-overtime.

On the afternoon of May 14, Mr. A. L. C. Fell, the chief officer of tramways, issued a notice that any employee who failed to report for duty on May 15 would be considered as having left the service. Various negotiations were taking place, and Mr. G. H. Hume, chairman of the Highways Committee, on May 15 discussed the situation with Mr. C. Watson, district secretary of the Amalgamated Association (which had come into the strike after it had been begun by members of the London and Provincial Union of Licensed Vehicle Workers), when Mr. Hume offered to expedite arbitration on all questions at issue, so that if the Conciliation Board did not agree arbitration might begin early in July. The men did not accept the offer and the strike proceeded.

The Highways Committee also pointed out in their report that the pay of motor men and conductors ranges from 5s. to 6s. 6d. per day, the men receiving the maximum rate forming nearly 80 per cent. of the whole. The men at the lowest figure were men engaged in room of those who had enlisted. Under the conciliation scheme the men were precluded from reopening the question of wages until June 26 next. The statements as to long spread-overs were greatly exaggerated. The average spread-over was 11 hours 27 minutes, or only one minute more than in June, 1914, when the agreement was made. The Committee further pointed out that very large concessions had been made to tramway employees within recent years, but the spirit exhibited by the men indicated a very unsatisfactory situation.

At the meeting of the Council at which the report was approved, Mr. Hume made a statement as to the difficulties which had been overcome in running a sufficient service of cars for Woolwich Arsenal workmen. In the general discussion which followed, members of the Council generally, including the Labour members, strongly condemned the strikers, especially in view of the war and the necessity for the arsenal services. Mr. Hume mentioned that an increase of 15 per cent in wages would cost £216,000 per annum.

Matters went on without change during the week, and on Saturday, May 22, the Council issued the following notice :—

"All men on strike who are eligible for military or naval service are instructed to forthwith return their uniforms and badges to the tramway depots. The London County Council are inviting men above military age to make application at once for positions as motormen and conductors for the period of the war."

This was a severe blow for the strikers, and it also had the effect of producing numerous applicants for employment. Many of these were engaged, and the work of training them was entered on at once.

Meanwhile the officials of the two trade unions concerned were negotiating and a joint committee had been formed. This body, on May 22, issued an order to the men to go back to work, as they said the County Council had promised arbitration. The fact was ignored that the Council had all along offered arbitration, but the men now seemed to think that the Council would retire from their position and take back men of military age as well as the others. When the men appeared for duty on Sunday, May 23, they found to their chagrin that no men of military age would be taken on. The older men thereupon refused to start work, and the strike continued. There were disturbances at depots and car windows were broken.

The car services were now improving, new conductors being at work and strikers gradually breaking away and coming in. A marked improvement occurred on Tuesday, June 1, in consequence of a notice issued by Mr. Fell on the previous day. It stated that the majority of the men above army age had returned to work and that, although men eligible for service with the forces would not be taken back, those who enlisted would receive favourable consideration for reinstatement after the war, and that any man of military age unable to enlist might appeal to the chief officer and state his reasons, and Mr. Fell would consider whether any special circumstances allowed an exception to be made. The issue of this notice was followed by the Strike Committee recommending all the employees above military age to return to work.

Thus the strike was closed, and on Wednesday, June 2, good services were run, though of course not up to the standard. Some men of military age were, owing to special circumstances, taken back, and the training of new men has gone on vigorously. It has been pointed out that the refusal to take men back is not a form of conscription, but the application of a decision of the Highways Committee of last September, barring the appointment of all fit men of military age. After over a fortnight, therefore, the strike proved a failure. The question of military age did not arise in the case of the Middlesex tramway men and they returned to work without restriction.

LONDON TRAMWAY FINANCE.

AN AGGREGATE CAPITAL EXPENDITURE OF £13,028,000.

The report of the district auditor on the accounts of the London County Council for the year ended March 31, 1914, gives the following statement showing the income and expenditure of the Council's tramways in respect of the two years ended March 31, 1914 :—

	Year ended March 31, 1913.		March 31, 1914.	
	Income.	Expend'tre.	Income.	Exp'nd'tre.
Electric traction ...	£2,213,307	£1,460,228	£2,247,043	£1,585,231
Horse traction ...	38,423	52,448	21,626	30,215
	£2,251,730	£1,512,676	£2,268,669	£1,615,466

The surplus on revenue (working) account for the year 1913–14 amounted to £653,202, made up as follows :— Surplus electric traction account £661,791, less deficiency on horse traction account £8,589. The net revenue account shows a deficiency of £88,526, which has been met out of the balance standing to the credit of the general reserve fund.

The Council on June 23, 1908, agreed that provision should be made for renewals in respect of the Council's electric tramways at the rate of two-thirds of a penny per car mile run, subject to the adequacy or otherwise of the provision on this basis being reconsidered at the end of five years. The Council at the same time resolved that the balance remaining on the net revenue account, after providing for renewals on the basis referred to, should be carried to the general reserve fund for providing for "general contingencies." On July 8, 1913, it was, however, decided, owing to the changed financial position of the undertaking, to postpone the review of the question until two years from April 1, 1913.

On the basis referred to above the sum required to be provided by revenue account and credited to renewals account during the year ended March 31, 1914, amounted to £166,086, but there was no amount available for transfer.

The balance to the credit of the renewals fund on April 1, 1913, was £633,010. The income for the year was made up of dividends, £19,524; appreciation on investments realised, £514; amount receivable from the London United Tramways, Limited, £1,088, a total of £21,726, making £654,736. From this amount was deducted the expenditure on renewals amounting to £114,987, leaving a balance on March 31, 1914, of £539,749.

The district auditor remarks that the charges to the fund in 1913–14 were £75,310 in excess of those of the previous year, and that there appears to be every probability of the expenditure on renewals increasing in future years. The deficiency of £88,526 was transferred to the net revenue account, leaving a balance in the general reserve fund of £190,597.

The net capital expenditure during the year, including £84,901 in respect of the cost of street improvements, amounted to £409,277. The aggregate capital expenditure to March 31, 1914, amounted to £13,028,120, which is made up as follows :—

In respect of electric traction	£10,944,664
In respect of horse and cable traction ...	207,821
In respect of obsolete lines, etc.	1,875,635
	£13,028,120

There are no existing assets representing the expenditure on obsolete lines, which were originally worked by horses.

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During the year £418,439 was transferred to the Consolidated Loan Fund in redemption of the debt of the tramways, and the aggregate amount set aside for the reduction of debt at the end of the financial year was £3,370,966. The debt outstanding at March 31, 1914, was £10,046,236. If, however, the sum of £122,708, the estimated value of surplus land acquired by the Council for tramway purposes, is deducted, there remains a net debt of £9,923,528. This amount is divisible as follows:—Electric traction, £8,839,176; horse traction, £126,749; obsolete lines, etc., £957,603.

AWARD IN NEWCASTLE DISPUTE.

TRAMWAY COMMITTEE'S SCALE OF BONUSES APPROVED.

The award of the Committee on production in Engineering and Shipbuilding Establishments engaged on Government work, under the chairmanship of Sir George Askwith, upon the subjects of difference between Newcastle Corporation and their tramways employees, to which reference was made in our issue of May 13, was issued on May 14. The statement of Sir George Askwith contains a summary of the whole dispute along with the award, which we quote in full:—

The following finding is in respect of an application made on February 9 by the Amalgamated Association of Tramway and Vehicle Workers for an increase of wages to tramwaymen in the service of the Newcastle-upon-Tyne Corporation. This application, together with requests affecting other employees of the Corporation, was considered by the City Council, and it was decided at a meeting held on March 22 that a "war bonus" of 2s. 6d. per week should be given to all unskilled employees in the service of the Corporation who are in receipt of less than 30s. a week, and a "war bonus" of 1s. 6d. a week to those in receipt of 30s. a week or more, but less than 40s. a week, youths and boys under 18 years of age to receive a "war bonus" of 1s. per week. The representatives of the tramwaymen intimated to the Tramways Committee that the men were dissatisfied with the suggested rate of "bonus," they emphasising the fact that, under the operation of the scale, while new entrants into the service (many of whom were young men temporarily employed to replace those who had joined His Majesty's forces) received the higher rate, the majority of the older servants of the Corporation (many of whom were married men and householders) received only the lower rate. It was acknowledged that this circumstance was present to a greater degree in the case of the tramwaymen than in the case of the other grades covered by the Corporation's decision, the majority of the latter coming under the lower scale of pay and therefore receiving the higher rate of "bonus." An alternative scheme, estimated to cost approximately the same as the scheme previously adopted by the Council, was accordingly submitted to the Council by the Tramways Committee, viz.:—

2s. 6d. per week to employees who are householders.
1s. 6d. per week to employees who are single men.
1s. per week to employees who are youths of 18 years of age or under.

This scheme was not accepted by the Council, who by a majority adhered to their former decision.

Following upon further indications of dissatisfaction on the part of the tramwaymen, it was agreed to refer the matter to the Committee on Production for decision. The committee accordingly heard representatives of the parties on April 26 and on May 7, and they have given full consideration to the arguments of the respective representatives and to all the circumstances of the case.

THE AWARD.

The Committee's finding is that the rate of payment of the "war bonus" to the tramwaymen should be as follows:—

To employees who are householders ... 2s. 6d. per week.
To employees who are single men ... 1s. 6d. per week.
To employees who are youths of 18 years of age ... ... 1s. 0d. per week.

The first payment should be made for the week commencing April 1, 1915.

G. R. ASKWITH.
FRANCIS J. S. HOPWOOD.
GEORGE S. GIBB.

We learn that, on being asked for his opinion on the award by a press representative, Mr. Goodhead, the men's representative, said that he was disappointed with the terms of the award, but that it would have to be accepted. The chief contention of the men had been for a flat rate, which the award did not grant, and therefore the single men who were old servants would not benefit to the same extent as the married men, though the single men who had dependants would be treated as householders.

Alderman J. H. Rodgers is stated on the same authority to have said that he was glad to find that the scale of increases drawn up by the Tramways Committee, of which he is chairman, had been endorsed and adopted by an impartial arbitration tribunal.

TRAMCAR OVERTURNED AT HALIFAX.

A serious accident occurred to a fully-loaded tramcar in Halifax on the evening of Saturday, May 22. The car, which was of the top-seated type, had a full complement of passengers, both inside and outside, and was running between Ovenden, Halifax, and Saville Park. It had safely descended the gradients between Lee Mount and Shoggs Road, but near the end of the latter the line turns sharply to the left. Here the car, instead of taking the curve, left the metals and turned to the right, running straight across the double track. When in this position the car toppled over on to its side. Windows were smashed, and the passengers were thrown off the top of the car, while those inside were pitched together into a struggling mass. Between 30 and 40 passengers were injured, six of them so seriously that they were detained in Halifax Royal Infirmary, to which they had been conveyed as speedily as possible.

The driver of the car, who had escaped injury, stated that he was driving slowly when the car left the metals. There is a Board of Trade stop at the bottom of Lee Bank, about 60 yards from where the accident occurred, and it is not yet clear whether the car came there to a dead stop, as required by regulations, or merely slowed down and then proceeded. It seems to be generally agreed that the driver had the car under complete control and that the brakes acted perfectly. Sudden application of the brakes after the car had left the metals may have caused it to swing round by the rear and so lose its balance. The gauge of the tramway tracks in Halifax, it should be stated, is 3 ft. 6 in.

Alderman C. F. Spencer, chairman of the Halifax Tramways Committee, accompanied by Mr. J. D. Caird, the general manager, visited the scene of the accident on Saturday night. In reply to inquiries, Mr. Spencer stated that no cause could be assigned for the accident, so far as he could see at the moment. The driver was an experienced man, and the fact that there was a Board of Trade stop within 50 yards of the place where the car left the rails showed that it could not have been travelling fast. At the curve where the accident occurred a check rail had been provided. A report of the accident has been sent to the Board of Trade, and an inquiry into the causes will be held in due course.

MISFORTUNES OF THE MEXICO TRAMWAYS COMPANY.

The directors of the Mexico Tramways Company have issued a circular to the bond and shareholders stating clearly the misfortunes which the company, together with the subsidiary undertakings of the Mexican Light and Power Company, the Mexican Electric Light Company, and the Pachuca Light and Power Company, has suffered through no fault of its own, but which has jeopardised millions of English and Canadian capital. In the first place the financial and political conditions in Mexico have become steadily worse and the country is now in a state of chaos, with business practically at a standstill. Some time ago the company's employees demanded an increase of 25 per cent. in wages and various other concessions, giving the board 48 hours to decide. The directors stated that this would ruin the company and refused. A strike was proclaimed and the services stopped. The authorities then took over the undertaking and doubled the salaries of many of the staff, and gave to the remainder of the employees a 25 per cent. increase in wages. The tramways have since been worked by officials appointed by the leaders temporarily in power. Operating costs rose steadily, and the character of the services and the condition of the equipment rapidly deteriorated. In addition, the maintenance of the cars was badly neglected, so that a very considerable proportion of the rolling stock is now laid up awaiting repair. For a short time the receipts were paid to the company's bankers, but subsequently the authorities directed that the earnings should be paid into the Government Treasury. It is now practically impossible to communicate (except after great delay) with the company's officials in Mexico, but the latest information states that when Carranza's representative was recently driven from the city of Mexico by Zapata he took with him the controller handles from the cars, thereby rendering them unfit for service, and all traffic has, consequently, ceased. So far the authorities have not taken over the control of the business of the allied companies, but their employees have been given higher wages, and there is practically no available surplus. The board are conferring with the trustees for the bondholders as to what further steps should be taken to protect the bondholders' interests, but they feel that the future of the enterprises they control must necessarily depend upon the development of political conditions in Mexico and the attitude of the United States towards that country.

Bonus on Profits to Tramwaymen.—In pursuance of an arrangement made since Mr. T. Bulfin became general manager, a bonus of 1½ per cent. on the profits of Bournemouth Tramways has been distributed among the employees. The distribution this year is on a basis of over £9,000.

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LONDON COUNTY COUNCIL TRAMWAYS.

SUB-COMMITTEES OF THE HIGHWAYS COMMITTEE.

The sub-committees of the Highways Committee of the London County Council, which is charged with the management of the Council's tramways, have recently been reconstituted, and are now composed as follow :—

(1) Accounts, Stores, and General Sub-committee (6).—Mr. A. O. Goodrich, Mr. H. H. Gordon, Mr. W. Haydon, Mr. William Hunt, Mr. A. Cooper Rawson, and Mr. S. Joyce Thomas.

(2) Tramways Management and Construction Sub-committee (8).—Mr. H. E. A. Cotton, Mr. D. Davies, Mr. Henry Marks, Mr. A. Cooper Rawson, Mr. A. H. Scott, Mr. W. J. Squires, Mr. S. Joyce Thomas, and Mr. A. W. Yeo.

(3) Tramways Staff (Special) Sub-committee (4).—Mr. H. E. A. Cotton, Mr. H. H. Gordon, Mr. W. J. Squires, and Mr. Henry Ward. The chairman of the Highways Committee, Mr. G. H. Hume, is *ex officio* a member of all sub-committees.

DECLINE IN TRAMWAY ADVERTISING.

In February, 1914, Messrs. W. H. Smith and Son entered into a contract with the London County Council for a term of nine years, by which they undertook to obtain orders for advertisements on the Council's electric cars, guaranteeing an annual minimum income to the Council, which for the first year would amount to £27,754. The Council have now agreed at the request of Messrs. Smith and Son to release them from any guarantee during the continuance of the war. Messrs. Smith and Son state that they have made every possible exertion to secure business for the Council, and have spent nearly £3,000 for the purpose, including £1,000 in publicity, but that owing to the war business has been at a standstill. They asked to be treated on the same terms that they have arranged with the railway companies, under which their guarantees are suspended during the war.

LONDON WORKMEN'S TRAINS AND TRAMS.

The London County Council has just issued a new edition of the penny pocket-book prepared by the Council showing the times of running of workmen's trains and trams in London and the neighbourhood, and the fares charged. The first part contains particulars of workmen's trains and other cheap morning trains between the London termini and each station to or from which workmen's tickets are available, and is arranged in alphabetical order of stations. The area covered extends beyond the County of London, and stretches from Barking to Uxbridge and from Enfield to Epsom. The second part of the pocket-book deals with the workmen's cars on the tramways of the London County Council, the Metropolitan Electric Tramways Company, the London United Tramways Company, and of other local authorities and companies, which serve, for the most part, the outer ring of London. This part is arranged according to routes, in alphabetical order of the outlying or principal terminus of each route, and is divided into two sections, the first containing the routes to Central London and the second the outlying routes. The pocket-book also contains information with regard to the dwellings for workmen provided by the London County Council. It is produced in a very handy form and should prove a useful book of reference for working men and other interested in travelling facilities in the metropolis.

NEW MEMBERS OF THE B.E.A.M.A.

The following firms have recently been elected members of the British Electrical and Allied Manufacturers' Association :—The Mirrlees Watson Company, Limited, John Musgrave and Sons (1913), Limited, Newton Brothers, Derby, and Isaac Storey and Sons, Limited (Branch of United Brassfounders and Engineers, Limited).

CHANGES OF ADDRESS TO ELECTRIC RAILWAY HOUSE.

On and after May 15, 1915, the address of the registered offices of the undermentioned companies will be Electric Railway House, Broadway, Westminster, London, S.W. (Telephone, Victoria 6800) : The London and Suburban Traction Company, Limited ; the Metropolitan Electric Tramways, Limited ; the London United Electric Tramways, Limited ; the South Metropolitan Electric Tramways and Lighting Company, Limited ; the North Metropolitan Electric Power Supply Company ; the North Metropolitan Electrical Power Distribution Company, Limited ; the Tramways (M.E.T.) Omnibus Company, Limited ; and the Gearless Motor Omnibus Company, Limited.

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

It is stated in the journal for May that no arrangements have yet been made for the annual dinner. A number of members have expressed the wish that an informal meeting of the members should be arranged during the coming summer, and this proposal is now being considered by the Council. It has been suggested that a day should be set aside for the reading of papers in London, and that in the evening the members attending might dine together informally. The secretary therefore requests any member wishing to read a paper to communicate with him at an early date, in order that the matter might be considered by the Council.

PERSONAL.

Mr. J. C. Whiteley, of Chatham, has been appointed general manager of South Shields Corporation Tramways.

Mr. D. A. Petruse has been placed in charge of the office of the electrical engineer of the North Western Railway of India.

Mr. J. H. Cardew, electrical engineer of the North Western Railway, India, has resigned from the Government service.

Mr. J. H. Howell, J.P., has been appointed a director of the Imperial Tramways Company, in place of the late Mr. Doggett.

Mr. C. L. Faunthorpe, assistant electrical engineer at Blackburn, has been granted a commission in the West Kent Regiment.

Prof. E. W. Marchant, of Liverpool University, has been elected chairman of the Liverpool Engineers' Society for the ensuing year.

Mr. L. J. Yorke, of the mechanical engineering staff of the London Underground Railways, who was gazetted to the 4th Yorks. Regiment in February last, left for the front early in May.

Mr. H. M. Taylor, borough electrical engineer of Middlesbrough, has resigned in consequence of his having received a commission as first lieutenant in the Royal Marines, Submarine Miners.

Mr. Frank Buckley, general manager of the Wigan Corporation Tramways, has been granted by the Council an increase in salary of £50 per annum, with a further increase of £25 in twelve months.

Mr. C. Beech, rolling stock superintendent of the Derby tramway department, has been appointed to a similar position at Bolton at a salary of £200 per annum. There were 93 applicants for the position.

Mr. J. Shepherd, electrical assistant of the London County Council Tramways, has resigned, and his resignation will take effect in September next. Mr. Shepherd proposes to act as consulting engineer.

Mr. G. Tough, electrical engineer and manager of the Coventry Municipal Electric Lighting Department, has been recommended by the Electric Lighting Committee for an increase in salary from £650 to £750 per annum.

Sir Joseph Jonas, chairman of the Applied Science Committee of the University of Sheffield, has given £5,000 to the University to endow and equip a testing laboratory in connection with the Applied Science Department.

Mr. J. D. Caird, traffic manager of Halifax Tramways, has been recommended by the Tramways Committee to receive an increase in salary from £350 to £375 per annum, with a further increase to £400 a year hence.

The Right Hon. Lord George Hamilton was elected chairman of the Underground Electric Railways Company of London at a meeting of directors held on May 18, in place of Sir Edgar Speyer, who had resigned office.

Mr. W. A. Stevens resigned the position of managing director of W. A. Stevens, Limited, as from May 1, and the management has been taken over under the joint directorship of Mr. Albert G. Micklethwaite and Mr. Percy Frost Smith.

Mr. F. Freshwater and his wife have been presented by the members of the staff of the Imperial Tramways Company, Stockton-on-Tees, with a solid silver tea and coffee service, suitably inscribed, on the occasion of their silver wedding.

Mr. A. Coveney, who recently resigned the position of electrical and tramways engineer of Erith Corporation, has been voted a month's salary in consideration of his services in a consulting capacity for two months after his resignation.

Mr. J. C. Cameron, who has been acting as general manager of the Northampton Corporation tramways for the past six months, has been recommended by the Tramways Committee of the Northampton Town Council for permanent appointment to the position, at a salary of £300, rising to £350 per annum.

Mr. H. E. Yerbury, deputy manager and engineer of Sheffield Electricity Supply Department, has been awarded by the Council of the Institution of Civil Engineers the Telford Premium (value £25) for the paper which he recently read before that Institution on "The Electrolytic Action of Return Currents in Electric Tramways on Gas and Water Mains."

Mr. W. T. Robson, who has vacated the position of general manager of South Shields Corporation Tramways to take up his duties as manager of Southampton Corporation Tramways, has been presented with a handsome wardrobe and a large framed photograph of the tramway men and staff, the gifts of the employees of South Shields tramways department.

Lieutenant-Colonel William Forbes was among the new Knights announced on the King's birthday. He is general manager of the London, Brighton and South Coast Railway, and commanding officer of the Engineering and Railway Staff Corps. During the war Sir William has rendered great assistance to the Government in connection with railway transport.

Grover and Company, Limited, after having carried on business for forty years at Wharf Road, City Road, find that their growing trade has necessitated the removal of their works, as it was impossible at the old premises to obtain room for further extensions. Their new Britannia Works, Carpenters Road, Stratford, E., are more commodious and better adapted to the work the firm is now carrying out.

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Mr. A. de Turckheim, the popular secretary of the Tramways and Light Railways Association, having learned that there has been some uncertainty among the members of the association as to his nationality, has published a note, with the permission of the chairman, the Hon. Arthur Stanley, M.P., in the Association's journal for May, stating that he was born in France of French parents. Since the age of 18 he has lived in British colonies and England, where he was naturalised as a British subject in 1899.

Mr. Alexander Mackenzie has been appointed President of the Brazilian Traction, Light and Power Company and its allied companies, in the place of the late Dr. F. S. Pearson. Mr. Mackenzie has had a long and extensive experience of traction and lighting business under South American conditions, having been closely associated with the Rio Janeiro Tramway, Light and Power Company and the Sao Paulo Tramway, Light and Power Company since their formation, acting for many years as general and legal representative of the companies in Brazil.

Dublin United Tramway Appointments.—The directors of the Dublin United Tramways Company have appointed Mr. George Marshall Harriss, the chief electrical engineer, as general manager. Mr. Tannan, a member of the electrical staff, becomes principal electrical engineer. Mr. Brophy, principal assistant to the late Mr. Gordon, has been appointed traffic manager. Mr. W. M'Hugh, the chief accountant, is appointed secretary in the room of the late Mr. Tresilian, and his principal clerk, Mr. Rathborne, succeeds Mr. M'Hugh as chief accountant.

Bristol Tramway Appointments.—Mr. W. G. Verdon Smith has been appointed managing director of the Bristol Tramways and Carriage Company in the place of Mr. Samuel White, who relinquishes the appointment owing to ill-health, but remains on the board. Mr. Verdon Smith has for more than twenty years been associated with the Bristol Company and secretary of the Imperial and London United Tramways Companies. Mr. G. Stanley White, of Messrs. George White and Company, Bristol, has been elected a director of the Bristol Tramways and Carriage Company in the place of the late Mr. H. G. Doggett.

OBITUARY.

Among the many useful and esteemed business men who lost their lives in the sinking of the *Lusitania* was **Mr. G. Maurice,** a director of the General Electric Company. Mr. Maurice had been in the service of the General Electric Company for 17 years, acting first as assistant to Mr. Railing in London, and subsequently being in charge of the fittings department. A few months ago he was appointed a director of the company.

Mr. Brodrick Clote, a director of Messrs. Vickers, Limited, was also among those lost in the *Lusitania*.

Mr. A. Norris, manager of the commercial vehicle department of De Silva and Wallace, Limited, Northumberland Avenue, London, was amongst those who lost their lives in the sinking of the *Lusitania*. Mr. Norris was returning from a visit to the works of the Pierce-Arrow Company, whose interests in this country are in the hands of Messrs. De Silva and Wallace. Previous to joining that firm Mr. Norris held the position of sales manager in the commercial vehicle department of Napier Motors, Limited, and was well known and highly esteemed in the motor world.

Mr. G. W. Gordon and Mr. R. S. Tresilian.—It is with regret that we have to record the deaths of Mr. G. W. Gordon, the manager, and Mr. R. S. Tresilian, the secretary, of the Dublin United Tramways Company. Mr. Gordon was killed by a fall from his horse in Herbert Park, Ballsbridge, on Thursday, May 27. Accompanied by his coachman, who was also on horseback, he was passing through the park when he suddenly dropped from the saddle and fell to the ground. An ambulance was summoned, and the deceased was taken to the City of Dublin Hospital, where it was found that life was extinct. Before entering Herbert Park Mr. Gordon had inspected the protection lamps of the Tramways Company on Pembroke Road, and was, it is understood, going to the tramway depot at Donnybrook. It was his usual practice to inspect the tramway depots on horseback in the mornings. The deceased was well-known and highly-esteemed in Dublin, and his sudden death has evoked widespread sympathy. Mr. Gordon was born in London, and was 68 years of age. He was appointed manager of the Dublin United Tramways Company in 1899, having previously occupied the position of secretary of the Tramways Union Company, Limited. Prior to this he was connected with tramways in Germany, France, and Roumania. He had an intimate knowledge of the working of the continental tramway systems, and spoke German, French, and Spanish fluently. The deceased also spent some time in Spain. His two sons volunteered for active service on the outbreak of the war, and hold commissions in the army.

Mr. Richard S. Tresilian, the secretary, died on May 29. He had been ill for a week, and was being treated in a private hospital, following an operation. Mr. Tresilian was appointed secretary in 1899, and was held in the highest esteem by the business community of the city as well as by the directors, officers, and employees of the company. By the deaths of their two leading officials, Mr. W. M. Murphy, the chairman, and the members of the board of directors have sustained a very great loss, while Dublin loses an estimable citizen. Mr. Tresilian, who was sixty years of age, had been associated with the company for more than forty years, and his knowledge of local tramway operating had proved of great value to his brother officers and the directors. In 1875 he became secretary of the newly-established North Dublin Street Tramways Company, and in 1880 he was appointed assistant secretary of the Dublin Tramways Company, of which the late Mr. William Anderson was secretary and manager. Upon the amalgamation of the tramway companies, Mr. Anderson became managing director, while Mr. Tresilian was advanced to the post of secretary.

The directors met on June 2, and passed the following resolution :—"The board has learned with profound sorrow of the deaths of their principal officers, Mr. R. S. Tresilian, secretary, and Mr. C. W. Gordon, manager. The death of these officials is a great loss to the company, and a cause of deep grief to the directors personally, by whom they were most highly esteemed. As the directors believe that the people of Dublin will share in their regret at the loss of two gentlemen who came so much in contact with the public, this minute of the board is communicated to the Press."

Harry G. Byng.—We regret to learn of the death from wounds received at Festubert of Second-Lieutenant Harry Gustav Byng, the third son of the late Gustav Byng (founder and late chairman of the General Electric Company, Limited). Lieut. Byng, who was born in 1889, was educated at Harrow, where he was captain of the school gymnasium eight, monitor and head of his house, for which he played both cricket and football; he also played for the Harrow Association football team. After leaving Harrow he joined Faraday House, and was awarded the silver medal in his year. He then completed his education at Harvard University, where he distinguished himself by his brilliancy, passing all his examinations with honours. There, as at Harrow, he enjoyed extraordinary popularity, both socially and as a sportsman. He was captain of the Harvard Association football eleven. When leaving Harvard he joined an exploring expedition into the lesser-known parts of Canada, and after a short return home joined the General Electric Company, Schenectady, as a pupil. He distinguished himself in the test room and was on the fair road to success when his duty towards his family called him back in order to assume a position in The General Electric Company

Lieut. H. G. Byng.

Limited. He settled in Warwickshire, so as to live near the works at Witton, and was on the point of assuming a position of responsibility when war broke out. His sense of duty to his country made him join His Majesty's Forces during the first week. He trained with the Artists' Rifles and went to France with them at the end of September, returning home on March 21 on five days' leave, during which time he married Miss Evelyn Curtis, of Boston and Beverley Farms, Mass., U.S.A. Immediately after he was gazetted Second-Lieutenant of the Second Battalion, Border Regiment, and fell in battle on May 16, near Festubert, in France, whilst leading his platoon. His commanding officer wrote :—"Mr. Byng was wounded whilst most gallantly leading his platoon in action on May 16. He was universally popular in the regiment. He had done very good work reconnoitering the enemy's trenches, and his loss is very great to the battalion." The adjutant of his battalion wrote :—"He was shot whilst leading his men, and fell actually on the enemy's trenches. He lay quite uncomplaining, and would not allow any of his men to carry him back, because of the danger to their lives."

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FINANCIAL REPORTS AND MEETINGS.

The Tramways and General Works Company, Limited, have declared a dividend of 6½d. per share, less tax, for the year.

Colombo Electric Tramways and Lighting Company, Limited, propose to pay a dividend of 10 per cent., free of tax, for 1914.

Auckland Electric Tramways Company have paid an interim dividend of 7d. per share, less income tax, on the ordinary shares.

Doulton and Company, Limited.—A final dividend at the rate of 5 per cent. per annum is announced on the preference shares for the past six months, making 5 per cent. for the year ended December 31, 1914, and carrying forward £31,626.

Newport (Mon.) Corporation Tramways.—The report for the year 1914-1915 states that the receipts were £41,720; passengers carried, 9,409,995; miles run, 964,895. In 1913-1914 the figures were:—Receipts, £40,151; number of passengers, 9,155,356; car miles run, 968,524.

Hong-Kong Tramway Company.—The directors report that, after charging £6,530 for depreciation and providing for debenture interest, the profits, including £7,655 brought forward, amounted to £17,022. A dividend of 10 per cent. on ordinary shares is proposed, writing off £2,000 on properties, and leaving £6,897 to be carried forward.

West Hartlepool Corporation Tramways.—The report on the Hartlepools tramways undertaking acquired some time ago by West Hartlepool Corporation shows a total trading surplus on the year of nearly £8,000. After paying interest on capital and redemption charges, there remains a net profit of £3,000, which it is intended to transfer to the reserve fund.

York Corporation Tramways.—The report of the York Corporation tramways for the year ended March 31 shows that the gross receipts amounted to £28,971; passengers carried, 6,712,631; car miles run, 766,360; receipts per car-mile, 9·07d. Compared with the previous year, these returns show an increase of £2,838 in receipts and an increase of ·21d. per car-mile.

Brisbane Electric Tramways Investment Company.—According to the directors' report, the accounts for 1914 show a divisible balance of £144,063. A final dividend of 4s. per share is proposed on the ordinary shares, making 8s. per share (8 per cent.) free of income tax, for the year, adding £50,000 to the reserve fund, and £7,000 to the insurance fund, and carrying forward £3,069.

Dudley, Stourbridge and District Electric Traction Company.—The directors report that the revenue for 1914 amounted to £50,790. After paying interest on debenture stock and placing £1,500 to renewals fund account, there is a surplus, including £75 brought forward, of £7,361. A dividend of 1 per cent. on the ordinary shares has been paid, leaving £851 to be carried forward.

Wolverhampton District Electric Tramways Company.—The report for the year 1914 states that the revenue amounted to £28,359. After deducting debenture interest, and providing £2,000 for renewals, the net balance is £2,484, including £134 brought forward. The directors recommend a dividend of 1 per cent. on the ordinary shares, place £500 to reserve, and carry forward £386.

Colne Corporation Tramways.—In his report of the year's working of Colne Corporation Tramways, the general manager states that, compared with the previous year, the receipts are down £1,606. This decrease he attributes entirely to the war, as up to the commencement of hostilities the receipts were on the increase. The total receipts amounted to £13,188, or 10·06d. per car mile. The total number of passengers carried was 2,363,118.

Swansea Improvements and Tramways Company.—The annual report shows a revenue for 1914 amounting to £66,716, a decrease of £2,030 on the previous year. After deducting debenture and other interest, payments to Swansea Corporation, and allowance of £5,500 for the renewals fund, there remains a surplus which, with £2,185 brought forward, amounts to £16,229. The directors propose to pay a dividend of 6 per cent. on the ordinary shares, and to carry forward £2,831.

Blackpool Corporation Tramways.—The accounts for the year ended March 31, 1915, show a surplus of £13,737, as against a surplus of £24,552 for the previous year. The total receipts for the twelve months amounted to £76,105, and the working expenses were £44,850. In making up the estimates for the present year, Mr. C. Furness, the general manager of the tramways, contents himself with saying that if the receipts amount to £60,000, there will be a surplus of about £2,500.

Yorkshire (Woollen District) Electric Tramways Company.—The directors' report for 1914 states that the revenue for the year amounted to £65,385, an increase of £2,876 over the previous year. After providing for debenture interest, and adding to renewals fund the sum of £4,500, there remains a net profit of £9,696. This, with £1,891 brought forward, enables the directors to recommend a dividend of 3½ per cent. on the ordinary shares, and that £2,000 be added to reserve, leaving a balance of £2,586 to be carried forward.

Bournemouth Corporation Tramways.—The annual report of the tramways manager, Mr. I. Bulfin, was presented to the meeting of Bournemouth Town Council, held on May 4. It shows that the total traffic receipts were £102,346, which is a decrease of £2,623 in comparison with the year 1912-13. The net profit for the year amounts to £9,350, and would have been much larger but for the fact that from August to March the sum of £2,352 has been paid to the dependants of the members of the staff who have joined the military forces.

Blackburn Corporation Tramways.—Mr. J. H. Cowell, general manager of the Blackburn Corporation Tramways, in his annual report on the working of the undertaking for the past financial year, states that the outbreak of war had an adverse effect on traffic which, in the early period of the year, promised to develop into a record. A careful adjustment of the service to traffic requirements, however, reduced the loss from this cause to a minimum. The decreases compared with 1913-14 were:—27,693 miles, 507,963 passengers, and £3,013 in receipts. The consumption of electrical power again shows a substantial decrease, working out at 1·54 units, as against 1·64 units, the cost being correspondingly reduced from 2·14d. to 2·01d. per car-mile. "Considering the circumstances" concludes Mr. Cowell, "and the increases in the price of material, I think the committee are again to be congratulated on the result of the year's working, which shows a net profit of £1,572 2s. 9d."

Lisbon Electric Tramways Company.—The directors of this company report that the result of operations for the past year, after deducting interest and amortisation due on the debentures of the "Campanhia Carris de Ferro de Lisbon," and after payment of £26,010 for interest on and redemption of the debentures of this company, also London office expenses and directors' remuneration, shows a net profit of £84,708, which, with £1,749 brought forward, make a balance of £86,457. After providing £15,000 for depreciation reserve and £5,000 placed to exchange reserve, there remains a balance of £66,457, out of which the usual 6 per cent. preference dividend has been paid. On November 12, 1914, an interim dividend of 3 per cent. on the ordinary share capital was paid, and the directors recommend the payment of a final dividend at the same rate, making 6 per cent. for the year. The balance of £2,883 remaining has been carried forward to next year's account. The tramways carried 63,758,037 passengers during the year, as compared with 58,840,923 passengers in 1913.

Electric Construction Company.—The report of the directors for the past twelve months shows a net profit, after providing £6,800 for debenture interest and £5,000 for depreciation, of £35,567. The sum brought forward from the previous year is £7,153, and the amount available for distribution is therefore £42,720. Deducting interim dividend of 7 per cent. per annum on the preference shares paid on November 30, 1914, amounting to £2,197, there remains £40,523, which the directors propose should be appropriated as follows:—Dividend on preference shares at the rate of 7 per cent. for six months, £2,197; dividend at the rate of 6 per cent. on ordinary shares, £13,452; transfer to general reserve fund, £17,402; balance carried forward, £7,471. By the transfer of a sum from general reserve account, the amount in shares in other companies has been reduced to what is considered realisable value, the general reserve fund now standing at £36,000. The vacancy on the board of directors caused by the death of Mr. William Bulloch has been filled by the election of Mr. David Willock, who has been in the service of the company for a period of eighteen years.

Nottingham Corporation Tramways.—In the report of the Tramways Committee for the year ended March 31, 1915, allusion is made to the three extensions which were completed during the year. The length of these extensions is about 6¾ miles of single track, bringing the total length of single track now worked by the Corporation to 44¼ miles. Twenty new cars have been added to the rolling-stock, and the number of cars is now 155. The traffic receipts showed an increase of £4,850 at the end of July, after which there was a general falling off to the end of the financial year. The total receipts amounted to £179,315, an average of 11·35d. per car mile, an increase of £3,935, but a decrease of ·52d. per car mile. The working expenses amounted to £112,583, equal to 7·13d. per car mile, compared with £108,273 and 7·54d. per car mile. The balance amounted to £66,731, compared with £66,957 for the previous year. This balance has been disposed of as follows:—To interest on stocks and loans, £13,833; repayment of capital, £23,732; reserve and renewals funds, £6,164; part cost of Parliamentary Bill, £502; in aid of general district rate, £22,500.

Belfast Corporation Tramways.—At a meeting of Belfast Corporation Tramways Committee held on April 26, the annual report of the general manager of the tramways, Mr. Nance, was received. The report states that the revenue amounted to £270,237, and the working expenses to £156,378, leaving a trading profit of £113,858, which shows an increase of £2,074 over the previous year. The charges, including interest on debt, an annual fixed payment of £8,961 to the General Purposes Fund, income tax, stamp duty, etc., amount to £61,824, leaving a balance of £52,033, compared with £51,257 for the preceding year. Allocation of the net surplus is prescribed by the Aberdeen clause of the Belfast Tramways Act,

(*Continued on page* 429.)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ...	May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington ...	Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne ...	Mar. 25, 1914	Aug., 1902	,,	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	May 15, 1914	Sept., 1901	,,	9 30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ...	Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ...	Mar. 25, 1915	Mar., 1899	,,	24 63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	68,302
Blackpool ...	Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford ...	Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	Mar. 31, 1915	June, 1903	,,	(b)36 10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	69,016
Chester	Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ...	Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ...	Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington ...	Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	Mar. 31, 1914	July, 1904	E.	22 20	239,980	239,980	...	245,332	11,026	177,676	67,656	(i) 32,356	E 51,126	1,048	52,174
			H.		...	...	...	...	...	...	...	...	H 429	19	448
Doncaster ...	Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham ...	Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	5,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ...	Mar 31, 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock ...	May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ...	May 15, 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster ...	Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool ...	Dec. 31, 1914	Nov., 1898	E.	124 0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ...	Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ...	Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ...	Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.) ...	Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ...	Mar. 31, 1915	Jan., 1901	,,	44 20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	179,315
Oldham	Mar. 25, 1914	May, 1902	,,	28 6	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
				(b) 8 31											
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth ...	Mar. 31, 1914	Sept., 1899	,,	15 0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ...	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall ...	Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	Mar. 31, 1914	May, 1902	,,	(i) 40 2	356,991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham ...	Mar. 31, 1914	Jan., 1903	,,	12 2	342,200	183,775	158,325	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ...	Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ...	Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ...	Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l) 26,881	37,744	586	38,330
Staly'ge, H., M., D.	Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport ...	Mar. 31, 1914	Aug., 1901	,,	27 5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey ...	Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1914	Dec., 1902	,,	19 44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow ...	Mar. 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington ...	Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham ...	Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.) ...	Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	Mar. 31, 1914	Nov., 1905	E.	98 54	1,528,146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead ...	Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	Mar. 31, 1914	July, 1902	,,	(e) 29 62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,403	104,353	616	104,969
Cardiff	Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry ...	Mar. 31, 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	May 31, 1914	Oct., 1898	,,	193 40	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
				(b) 2 53											
Huddersfield ...	Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester ...	Dec. 31, 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	Mar. 31, 1914	...	H.	13 73	...	...	...	...	...	...	...	...	21,145	480	21,635
		May, 1903	C.E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	Mar. 31, 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ...	Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth ...	Mar 31, 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	Mar. 25, 1914	Sep., 1899	,,	79 3	1,640,371	1,426,217	214,154	1,521,439	19,250	1,073,612	463,575	30,378	386,114	3,562	389,676
Wellington, N.Z.	Mar. 31, 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes 13 miles 21 chains leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1¼ miles railless trolley route. (i) 17 mi 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit.	Deductions from Gross Profit.						Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	(h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RT 1,310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,294	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,005
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	(m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,526
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund. (d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account. (h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account. (r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines. (x) Includes £365 profit motor char-a-banc. (z) Includes £6,519 rent of leased lines. ‡ £2,950 profit from 8 months' working. * Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile. d.	Average Traffic per Car Mile. d.	Traffic. d.	General. d.	Repairs and Maintenance. d.	Power. (Price paid) d.	Total. d.	%	d.	Units.	Cost per Unit. d.	Units used per car mile.
Aberdeen	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	610.413	1·25	1·38
Ayr	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421.844	1·39	·94
Birmingham	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	445	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E 10·358	10·150	3·438	·577	1·092	1·709	6·816	65·8	5·107	1,425,112	1·45	1·179
				H. 6·077	5·821	7·325	...	1·099	...	8·424	138·6	...	...	...	...
Doncaster	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham	E. ...	4,287	750	12·54	12·52	2·92	·87	2·22	2·79	8·80	70·15	6·01	1,731,184	1·375	2·03
	R.T. ...	1,009	...	10·74	10·74	2·44	·76	2·68	1·23	7·11	66·20	5·88	120,303	1·375	1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport	...	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	2,479	...	1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838 649	1·68	1·164
Walthamstow	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1 1/16	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile. *					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		Works Cost.
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile. d.	Average Traffic per Car Mile. d.	Traffic. d.	General. d.	Repairs and Maintenance. d.	Power. (Price paid) d.	Total. d.	%	d.	Units.	Cost per Unit. d.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21	8·94	3·32	·76	1·41	1·01	6·50	70·55	5·49	154,048,461	·601	2·63
				H. 8·15	7·97	4·07	1·39	1·53	4·40	11·39	139·72	11·39	...	...	...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth	10,702	(i) 3,000	5,041	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30,581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
	Traffic Records.															
					d.			£		d.	Miles.	d.	Miles.			
Aberdeen ...	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10/3	·508	1·80	·58	7·5	703	54	77
Accrington...	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11/1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,121,769	12,223,569	10·89	1·28	61·12	105	2,528	6/6	·902	1·25	·76	7·50	434	31	61
Blackpool ...	67,500	1,075,943	14,283,802	13	1·41	211·7	86·7	4,524	24/9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,036	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6/3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613,357	15,513,264	9	1·07	121·47	99·73	1,904	10 9	·554	1·30	·77	8·54	...	...	54
Chester	39 028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5/5	·78	1·38	·75	7·33	126	7	17
Colchester ...	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4/8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon ...	178,094	2,801,302	19,227,878	6·87	1·06	107·96	129	4,818	9·10	·871	2·05	·50	8·14	942·23	59	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880 H. 17,710	12,136,148 110,231	10·039 6·224	1·011 ·935	97·88	...	2,398 ...	8/3	·67 1·35	1·44 1	·75 1	6·375 ..	... ...	... ...	50 3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8/2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax ...	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12,4	·867	1·30	·87	7·23	853·93	77	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,256	5/7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52 8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	183	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6/11	·532	1·75	·428	7	90	5	8
Liverpool ...	840,000	13,687,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	...	...	..	662
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	264,000	3,789,857	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	...	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd...	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10·9	·751	1·12	·88	9	247·5	15	24
Rochdale ...	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham...	64,000	E 852,639 RT 128,685	9,874,231 471,690	11·58 3·67	1·08 2·72	154·3 ...	...	3,701 ...	13,9 ...	·76 1·92	...	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,843,941	13,162,224	8·52	1·23	108	77·38	3,624	11/1	·82	1·25	·55	...	...	...	70
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·63	6·66	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	..	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham ..	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·51	7·75	1,235	95	118
Wigan ...	200,000	1,500,846	14,235,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	83	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York ...	82,600	707,370	5,946,845	8·41	1·05	72	108	2,193	6·2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6/4	·831	1·18	·866	6·4	476	40	46
Glasgow ...	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds ...	525,000	9,204,331	93,679,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester ...	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ...	...	E58,372,356 H 636,933	516,338,859 ,613,781	8·82 10·38	1·01 ·77	...	120·18 77·12	7,866 1,519	... ...	·73 1·09	...	...	9·08 5·85	17,728·8 203·14	1,335 23	1,722 56
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6·4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9/2	·54	1·59	·68	7·5	352	26	36
Sheffield ..	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16·1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,895 miles coal haulage. (b) Total expenses per passenger.

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1904, in proportions as follow :—Sinking fund, £31,276 ; depreciation fund, £17,000 ; general purposes fund, £3,757. Mr. Nance calculated that the undertaking lost £21,600 in receipts between August 1 and the end of the financial year, owing to the war. The loss was balanced to a certain degree by a reduction in expenses amounting to £12,000. The special payments to dependants of tramway employees who had enlisted involved a charge of over £3,058, which was charged to the general expenses account.

Anglo-Argentine Tramways.—The report of the Anglo-Argentine Tramways Company for the year 1914 states that the gross receipts amounted to £2,850,995, as against £2,963,191, for the previous year, while the working expenses, which includes £150,000 placed to depreciation renewals reserve, in addition to £293,697 expended on ordinary maintenance, came to £1,880,966, as against £1,969,160 last year, when £150,000 was placed to depreciation renewals reserve, in addition to £347,650 expended on ordinary maintenance. Inclu ling interest and the amount brought forward, the net revenue amounted to £1,013,797, as against £1,023,926 for 1913. After providing for interest and other charges amounting to £917,388, the directors, having regard to the decrease in the traffic receipts for the current year, as compared with those of 1914, and the uncertainty of the outlook for the remainder of the year 1915, have decided not to recommend any dividend on the ordinary shares but to carry the balance of £96,408 forward. For 1913 a dividend of 6¾ per cent. on the ordinary share capital was declared, leaving £13,240 to be carried forward. The board specially acknowledge the services rendered during a year of exceptional stress by the members of the local committee, the general manager, and the staff of the tramways generally.

Manchester Corporation Tramways.—The annual report of the Manchester tramways, which was submitted to the Tramway Committee on May 18, shows that the revenue for the year from all sources amounted to £901,875. After deducting working expenses and war allowances, the balance, including bank interest, stood at £312,285. There was a decrease in the revenue of £23,431, compared with the previous year. The Corporation now has 194 miles 1,719 yards of track, including mileage over which it has running powers. The rolling stock consists of 683 cars. The total number of passengers was 202,768,420. The weekly allowances to men with the colours and their dependants comes to £1,316, and the list of contributions made to various war funds aggregates £11,286. On a system consisting of 194 miles 1,719 yards single track, operated by 683 cars, mostly double-decked, the number of electric units used during the year was 29,922,197. The average price per unit was 1·029d., and the consumption per car-mile was 1·502. The percentage of working expenses to receipts was 63·47. Traffic revenue per car-mile was 11·123d., and working expenses per car-mile amounted to 7·172d. Average fare paid per passenger was 1·06d., the average number of passengers per car-mile being 10·6. For a total capital expenditure of £2,216,008, there is provided a sinking fund amounting to £548,498. The amount of sinking fund applied in reduction of debt is £547,711, and the renewals and depreciation fund was £428,000 in 1915. Since 1912 the tramways department has contributed to the rates of the city an annual sum of over £100,000. The figures are :—1913, £100,000 ; 1914, £103,000 ; 1915, 100,000. In the thirteen years of its existence the tramways department has relieved Manchester rates to the extent of £915,000.

British Thomson-Houston Company.—In their report for the year 1914 the directors observe that prior to the outbreak of war the company was making excellent progress in all its departments, but the business was seriously disturbed in many directions in August and September last. Readjustments were made to cope with the new conditions in order to fill orders to meet directly or indirectly the requirements of the Government, and at the same time to carry out as far as possible the obligations to other customers. It was gratifying to note that in spite of the disturbed financial conditions, collections were excellent throughout the year. The profits amounted to £130,867, and the sum of £12,944 was brought from last year, making a disposable balance of £143,811. Interest on debentures and loans requires £56,704, leaving a net profit of £87,107. Of this amount the sum of £173,309 has been appropriated for depreciation, so as further to strengthen the company's position, and £13,797 has been carried to the new account. Over 1,000 of the company's employees have joined the colours, a large percentage of those eligible for military service. The loss of this number of men has been a source of considerable embarrassment to the company, which for months past has been manufacturing munitions of war at their various factories. Mr. George Franklin, who presided at the annual meeting of this company on May 12 last, said that the past year had been a most difficult one, and they were greatly indebted to the loyal and efficient way in which the whole of the staff had done their work. As mentioned in the report, a great many of their employees had joined H.M. Forces, and they had made suitable provision for their families during the time they were serving. The net profit for the year showed an increase of £11,000 over that for 1913, and in agreement with the most important shareholders, they had decided to utilise the sum to further strengthen the position of the company.

CONTRACTS AND ORDERS.

Dick, Kerr and Company's tender for 40 H.P. tramcar equipment has been accepted by East Ham Town Council.

British Thomson-Houston Company's tender for 160 tramcar motors has been accepted by West Ham Town Council.

Alfred Wiseman, Limited, have obtained the contract for the supply to Yarmouth Corporation Tramways of 36 split-gear wheels at £3 3s. each.

Edison and Swan United Electric Light Company's tender for twelve months' supply of electrical stores has been accepted by Dundee Corporation.

Brighton Town Council have accepted the tender of Richardson, Westgarth and Company, Limited, for a service condenser for Southwick Power Station at £1,925.

Bradford Tramways Committee have accepted the tender of Hadfields, Limited, at £572, and Edgar Allen and Company, Limited, at £414, for points and crossings.

The British Westinghouse Company's offer to supply two 500 KW. rotary converters has been recommended by the Tramway Works and Stores Committee of Glasgow Corporation for acceptance.

British Insulated and Helsby Cables, Limited, have a contract from the Mount Lyell M. and R. Coal, Limited, for the sale to them of 250 tons of electrolytic copper (E.S.A. brand) monthly.

Newport (Mon.) Electricity and Tramways Committee have accepted the tender of Messrs. Partridge, Jones and Company, and of Messrs. James and Emmanuel, each for 1,000 tons of coal at 19s. per ton.

Messrs. Cammell, Laird and Company, Limited, have received an order for the whole of the Manchester Tramway Committee's requirements for steel tyres, the order for these, previously placed with another firm, having been rescinded.

The General Electric Company, Limited, are to supply to Halifax three rotary converters, transformers, and switchgear for the conversion of sub-station plant to 3-phase 50-cycle alternating current supply. The amount of the contract is £2,563.

Glasgow Tramways Committee have recommended the acceptance of tenders for steel axles, tyres, and wheels from John Baker and Company, Limited, Glasgow Railway Engineering Company, Limited, and Brown Bayley's Steel Works, Limited.

Messrs. Duncan and Fraser, of Adelaide, have received an order from the Melbourne, Brunswick, and Coburg Tramways Trust for 12 cars. This tramway system is now under construction, and it is expected that service will be commenced early next year.

Clough, Smith and Company, Limited, of Regent House, Kingsway, London, W.C., have secured from the Grangetown, North Ormesby, and South Bank Railless Traction Company the contract for the construction of their overhead equipment and feeder system (a route length of 5 miles 61 yards).

Edison Accumulators, Limited, as reported in a recent issue, have received an order from Dover Town Council for electric vehicles for scavenging. The tenders received were as follows :—Edison Accumulators, Limited, £6,760 ; General Vehicle Company, Limited, £5,850 ; Wolseley Motor Company, £6,490.

An Australian Contract.—A press report states that Messrs. Norton, Griffiths and Company have entered into a £10,000,000 contract with the New South Wales Government for railways, water conservation, harbour and irrigation works, the expenditure to be spread over a period of five years from July, 1915.

Siemens Brothers Dynamo Works, Limited, have received notice from the Rochdale Corporation Tramways of the acceptance of their tender for the supply of Wotan traction and standard lamps. They have also received an order from Leith Corporation Tramways for the supply of filament lamps for the ensuing twelve months.

The Equipment and Engineering Company, of 2 and 3, Norfolk Street, London, W.C., have received orders, totalling nearly 2,000 tons, for brass rods for the manufacture of shells. These orders are in addition to orders for many hundreds of thousands of brass cartridge blanks, discs, and cups, and over a quarter of a million copper driving bands.

The Mirrlees Watson Company have recently received orders for the following condensing plant :—Torquay Corporation (third set), South Leicestershire Colliery Company (two sets), Millom and Askem Hematite Company, Limited, per Messrs. Fraser and Chalmers (fifth set), Compagnie Française Thomson-Houston, Paris, for Tuiliere Power Station (fourth set), also for Athens Power Station (third set), Tharsis Sulphur and Copper Company, Limited (three sets), and plant for Bourges (France), Senegal, Russia, Japan, Straits Settlements, and West Indies.

Edward Bennis and Company, Limited, are very busy in executing war contracts. Not less than 80 per cent. of the work in hand for mechanical stokers, coal elevators, conveyors, ash handling plant, etc., is intended for factories producing munitions. Official exemption badges have been supplied to all recruitable workers in their employ, they having given a guarantee that they will enlist if called upon, as the firm have been officially notified that they have been placed on the list of those exempt from recruiting in consequence of being engaged on war contracts.

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TRAMWAY AND LIGHT RAILWAY NOTES.

ABERDEEN.

Women Conductors Employed.

The Tramways Committee of Aberdeen Corporation have been obliged to consider the expedient of employing women as tramway conductors. Their experience has been typical. First, when the tramway service was denuded of numbers of experienced drivers and conductors by enlistment, the committee called in the reserves of labour in the city; next, it became the imperative duty of the committee to restrict tramway employment to men ineligible for military service; next, the service of tramways was rearranged, much overtime being worked; finally, the question of employing women as conductors has been forced upon the consideration of the tramways management. At a meeting held on May 14, the Tramways Committee resolved to recommend that women conductors be employed. The tramway men held a meeting of protest, but to no purpose; eight women have been engaged and are being trained.

BIRMINGHAM.

Increase of Fares.

At a meeting of the Tramways Committee on May 18, at which Councillor Harrison Barrow presided, it was officially announced that it would be necessary to raise the fares. Allowances to soldiers' dependants would absorb about £35,000 this year, the increase in wages will amount to £16,000, and the increased income tax to £10,000, making a total of £61,000. It is anticipated that there will be a considerable loss due to the wastage of electrical energy through the inexperience of new drivers. If steps were not taken to put up fares it is stated that there would be little for the reserve fund at the end of the year. At a special meeting of the Tramways Committee held subsequently, a revised scale of fares was adopted. The average length of the penny stage at present is 2 miles 600 yards; on the proposed scale the penny stage will be reduced to 1 mile 1,200 yards. On the whole, the practical effect will be to change the penny stages into three halfpenny stages, the three-halfpenny into twopenny stages, and so on, increasing a halfpenny on each stage. Workmen's tickets will be issued at a halfpenny extra on the return journey. The increases were sanctioned by the Council on June 1.

BOLTON.

A Three Days' Strike. Proposal to Abolish Penny Fares.

After being stopped for three days, owing to a strike of the tramway men, Bolton Corporation Tramways resumed service on Monday, May 24. The men had struck work because of a dispute with the management in regard to the overtime at week-ends entailed by the shortage of workers. An amicable arrangement has been made. On their part, the men have agreed to undertake the extra work voluntarily, and the Tramways Committee have promised to consider the question of a war bonus and the other grievances which the men brought forward. Bolton Town Council have lately been seriously considering what measures should be taken to reduce the loss of the tramways undertaking of the town, and it was suggested at a recent meeting that the length of the penny ride should be reduced, or even the penny fare altogether abolished.

BRADFORD.

A Novel View of Halfpenny Fares.—Effect of Early Closing.

Speaking at Bradford City Council meeting, held on May 11, Mr. Hill presented an interesting view on halfpenny fares. He said: I again submit to the Council my firm conviction that a general penny car fare within the city would go far towards reform in the overcrowding of the centre of our city. I do not believe that people desire to live in the smoke and grit, nor to be herded together as most of them are, but it is often a matter of stern necessity. I believe, however, that halfpenny fares for short stages encourage people to live within a narrow radius, and so assist in congestion. Mr. C. J. Spencer, manager of the Bradford Corporation Tramways, reported to the Tramways Committee that since the closing of public-houses at eight o'clock and lighting restrictions began, the tramways traffic had declined considerably after that hour, and he has been given powers to adjust the service to the changed conditions.

BRIGHTON.

Women Conductors.

Brighton Corporation has reconsidered its decision not to employ women as tramway conductors. The manager, Mr. W. Marsh, presented a report in which he pointed out that the supply of suitable men seemed to be on the point of giving out, and the difficulty would probably be greater later on. He suggested that nearly all the objections which had been raised against the employment of women would vanish as soon as a little experience had been gained. The Committee resolved to recommend to the Council that the manager be authorised to engage women for training as conductors, and that the wages of the women conductors be the same as the commencing wage of male conductors viz., 4¾d. per hour, and that the hours of labour be eight hours per day.

BURY.

Tramway Goods Service.

The Bury Chamber of Commerce recently sent a resolution to the Associated Chambers of Commerce expressing the view that much advantage would be obtained by the use of municipal tramways for the carriage of goods. It is stated that the manager of the Bury tramways, Mr. W. Clough, has favourably considered the proposal, and is prepared to give information to persons wishing to use the tramways in the way proposed.

CARDIFF.

Boys as Conductors.

The difficulty tramway authorities are meeting in their efforts to maintain the services was illustrated by a letter read at the meeting of Cardiff School Attendance Committee held on May 7. The letter was from Cardiff Corporation Tramways Committee, asking the committee whether they could release any boys of school age for service as conductors on the tramways. The School Attendance Committee decided to reply that boys of school age could not be released, one of the reasons being that it was not desirable that boys of tender age should be entrusted with money, as would be the case if they acted as conductors.

CROYDON.

Weekly Tramway Tickets.

The South Metropolitan Tramway Company have adopted a system of issuing weekly tramway tickets on their lines between Sutton and Croydon, and Croydon and Tooting. When issued, the ticket is punched, marking the week for which it is available; thereafter the ticket is clipped once each journey.

DONCASTER.

Free Tramcar or Taxicab Rides.

It appears from the reports of Doncaster Town Council meetings that the Councillors have been somewhat misrepresented in regard to the free passes on the tramcars they had recently voted themselves. We now learn that Doncaster Town Councillors formerly enjoyed the privilege of riding in taxicabs at the expense of the Corporation when travelling on Town Council business. Instead of riding in the lonely luxury of the motor cab, the Councillors have decided to share the democratic tramcar with their constituents, and incidentally save the ratepayers' money. What appeared to be a selfish indulgence, turns out to have been a self-denying ordinance; but it is the privilege of great men to be misunderstood.

DUNDEE.

Free Passes for Soldiers.

The question of continuing the grant of free passes on the tramways to soldiers was considered at a meeting of the Dundee Corporation Tramways Committee held recently. It was stated that the cost of the concession was greater than the financial position of the undertaking could bear, and that ordinary passengers were prevented from using the cars at certain busy hours owing to the crowding of soldiers on the cars. It was agreed that the use of free passes should be continued to the military under restricted conditions, on a plan drawn up by the tramways manager and the Lord Provost.

GLASGOW.

Vehicular Traffic and Tramway Stops.

A new by-law of Glasgow Corporation for the regulation of vehicular traffic near tramway stopping places came into force on May 1, and the first case under it was recently heard by Bailie Barrie at the Southern Police Court. A taxi-cab driver was charged with having failed to draw up his cab at a point near a tramway stopping place before the roadway was clear of passengers entering or leaving a tramcar. A fine of £1 1s. was imposed, and the magistrate said that the practice of driving among passengers who were boarding tramcars must be stopped.

IPSWICH.

Advertising for Women Conductors.

Mr. F. Ayton, general manager, Ipswich Corporation Tramways, caused an advertisement to be inserted in the local papers, stating that the Electric Supply and Tramways Committee, having arranged to release a number of conductors in order that the latter, so soon as their places can be filled, may be employed in the production of munitions of war, the manager would be pleased to receive offers of service as temporary tramway conductors for the period of the war, or such shorter period as may be necessary, from women above 21 years of age. They are to be paid the commencing wage given to male conductors of full age, namely, at the rate of 22s. per average week of 60 hours, 10 hours per day. Sunday duties are worked in rotation. Uniform overalls and hats to be provided. The response to the advertisement was a great rush of applicants, and 26 women have been put into training as conductors.

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LEEDS.

EXTENSION TO HALTON.

The extension of Leeds Corporation Tramways from York Road terminus to Halton has been opened. This seems likely to be the last tramway extension in Leeds for some time to come, owing to the restrictions which the Local Government Board have placed on capital expenditures by local authorities. Apart from the financial considerations, however, the Leeds Corporation have offered to release between 500 and 600 employees for war service, and the diminution in the supply of labour will interfere with the carrying out of several schemes. The trackless car extension from Guiseley to Otley and Burley-in-Wharfedale is being held up because of accumulations of gas which have been encountered when workmen opened up the track to lay cables.

LONDON.

POLICE COMMISSIONER INTERVENES.

Other instances of the interference of the Metropolitan Police and City Police with tramway development, which we noted in a recent issue, occurred in connection with the proposal of the London County Council, passed recently by the House of Commons Committee, to lay a tramway in Mansell Street and to make extensions in South Hackney. On the advice of the police, who declare that tramways in Mansell Street would seriously interfere with the traffic passing over Tower Bridge, the City of London Corporation opposed the measure. In regard to the extension in South Hackney, the police lodged objection to proposed short lengths of track in Well Street, but the committee over-ruled the objection and passed the proposals.

LIVERPOOL.

MILITARY CENSUS OF TRAMWAYMEN.

Liverpool Corporation Tramways Committee resolved at a meeting held on May 20, that a census be taken of the employees of the department to ascertain who are eligible for military duty, with the view of encouraging them to enlist.

PERTH.

TRANSFER OF TRAMWAY INSURANCE CONTRACT.

The Tramways Committee of the Perth Corporation have decided to take the insurance of the tramways undertaking from the General Accident Fire and Life Assurance Corporation, the headquarters of which are in Perth, and place the contract with the Municipal Mutual Insurance Company, London, at a saving which is said to amount to 40s. per annum. The actual economic gain does not seem obvious; in fact, it seems that the community of Perth stands to lose by the short-sighted parsimony of the city fathers.

PRESTON.

NO "SHIRKERS" TO BE TRAMWAY CONDUCTORS.

The Tramways Committee of Preston Corporation have employed women conductors, owing to the undesirability of filling up the vacancies caused by men joining the colours with others who ought to take the same course. A large number of applications were received from women.

PLYMOUTH.

UNIFICATION OF THE LOCAL TRAMWAYS.

The minutes of Plymouth Corporation Tramways Committee submitted to the meeting of the Borough Council held on May 10, contained the following important resolutions:—The special sub-committee reported that the Devonport and District Tramway Company were willing to sell their undertaking to the Corporation on Tramway Act terms at once, instead of in 1919, the Corporation to have immediate possession, and the price to be fixed by arbitration. Resolved that the terms be approved, and that an agreement be entered into with the company. The sub-committee further reported that the Plymouth, Stonehouse and Devonport Tramway Company were willing to hand over their undertaking to the Corporation at once, instead of in 1922, on terms to be agreed. Resolved that an agreement be entered into accordingly, and in the event of a difference as to price, the same be settled by arbitration. The Council agreed by a majority to accept the recommendations of the Tramways Committee.

RAWTENSTALL.

HALFPENNY FARES.—RETURN TICKETS.

The Tramways Committee of Rawtenstall have decided to introduce halfpenny fares, and the stages for the fares have been fixed, though the whole of the necessary arrangements are not yet quite completed. The committee also have instituted a system of return tickets whereby passengers may travel from any point to Lovecleugh or Water, walk over the hill, rejoin the car, and return to the original starting point. The fare is sixpence, and it is said that the concession will be a great boon to the residents and tourists in the district.

SALFORD.

ON BEHALF OF WOMEN CONDUCTORS.

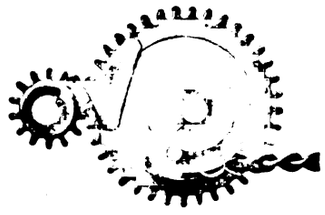
Mr. G. W. Holford, manager of the Salford Corporation Tramways has issued two notices "on behalf of the women conductors," one to the motormen, asking their co-operation with the women in maintaining the service, and one to the passengers on the cars. The notice to passengers reads as follows: In consequence of the difficulty experienced in obtaining sufficient suitable men at the

Note the STOPS which form the special feature of The "Peacock"

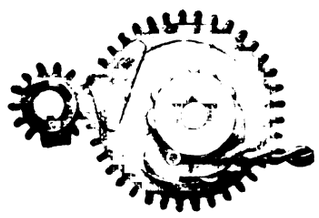
IMPROVED BRAKE

(Patent),

and by preventing the drum from over-running on release, save three-quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



WINDING.

"PEACOCK" BRAKES

(PATENT)

Have been supplied to the following tramways amongst others:—

MANCHESTER . . .	698
BIRMINGHAM . . .	458
SALFORD	428
METROPOLITAN . .	728
CROYDON	150
HASTINGS	130
WAKEFIELD . . .	130
NOTTINGHAM . . .	112
RHONDDA	108

NOTE.—The stops being cast solid with the wheel and pinion in no way detract from the simplicity of the Brake nor increase the cost of maintenance.

The "PEACOCK" BRAKE CO., 27, Clements Lane, LONDON, E.C.

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present time in order to maintain a satisfactory service on the various routes, the Tramways Committee have decided to appoint females to act as emergency conductors on a number of the cars. The committee desire to appeal to the good feeling of the travelling public for their kind co-operation and consideration under these new conditions. They trust that with this additional help they will be able to meet the convenience of the public and maintain a service sufficient for the present requirements.

SOUTH STAFFORDSHIRE.

A Strike Averted.

For some considerable time there has been unrest among the employees of the British Electric Traction Company operating the company's tramways in the South Staffordshire area. After extended negotiations the company offered a bonus of 2s. per week to all the men, or, as an alternative, were willing to refer the matter to Board of Trade arbitration. The men declared for a permanent increase of wages, and held a meeting at Dudley, on Friday, May 21, to decide on whether a strike should be declared or not. At the meeting a resolution to accept the Company's offer of a 2s. war bonus was carried by 72 to 62 votes, many of the men present abstaining from voting.

TORQUAY.

Parcels Delivery.

Torquay Tramways Company have intimated their intention to institute a parcels delivery service in Torquay and Paignton.

WEST HAM.

Obstruction of Tramways by Unsound Vehicle.

At West Ham Police Court on Tuesday, May 4, a carman was summoned for using an unsound vehicle and obstructing the tramways at Plashet Road, Upton. Evidence showed that the van driven by the accused collapsed on the tramway track through the decayed condition of its wheels. The carman was fined £1, and the owners of the van £2.

YORK.

Treasury Sanctions Expenditure.

York Corporation Tramways Department were recently placed in a difficult position by the restrictions imposed by the Government on the expenditure of local authorities, as the Corporation was at that time actually liable for the cost of tramway construction which would be stopped by the order of the Treasury. The Lords Commissioners of the Treasury, in consideration of the facts, have since intimated to York Corporation that they will sanction the loans required for the completion of the works already begun.

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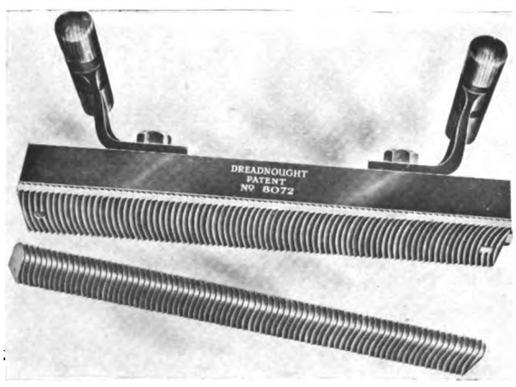

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PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

Applications.

The following Applications for Letters Patent have been filed:

6,197 Controlling mechanism for automobiles—British Thomson-Houston Company, Limited (*General Electric Company*).
6,311 Means for preventing a train from running past its signal—A. E. Powell.
6,362 Automatic signalling for tramways or electric railways—D. Samaia.
6,413 Manufacture of tire covers or casings—Dunlop Rubber Company, Limited, and C. Macbeth.
6,499 Railway signalling apparatus—E. S. Tiddeman.
6,542 Electric signalling system for railways—W. J. Mackenzie.
6,545 Coupling or combined buffer and coupling for railway vehicles—H. C. Carter.
6,578 Car trucks—J. E. Anger.
6,601 Railway signalling—W. R. Sykes Interlocking Signal Company, Limited, and R. W. Tarrant.
6,602 Keys for securing rails in their supporting chairs—G. F. Williamson.
6,626 Motor vehicle bodies—B. A. Ashton.
6,676 Automatic coupling for railway cars—K. Serguienko.
6,686 Joint connections for railway rails—R. N. Hill.
6,690 Railroad ties—I. S. Fisher and T. E. Ralph.
6,712 Switch with rocking tongue for tramways and railways—M. Grimaldi.
6,715 Electrical generators for lighting mechanically-propelled vehicles—H. C. H. Smyth.
6,818 Automatic switches of electric train lighting systems—W. King.
6,820 Brake blocks for railway and tramway vehicles—A. Chaumont.
6,850 Variable-speed driving mechanism for motor road vehicles—C. H. Ingall.
6,851, 6,852 Motor vehicle bodies—G. Maddox.
6,915 Brake operating gear—F. van der Straeten.
7,135 Brakes—T. H. Wigger.
7,177 Switching-over apparatus for electrical lighting installations for railway trains—H. Grob.
7,217 Automatic coupling for railway vehicles—J. W. Cloud.
7,221 Motor road vehicles—F. R. Simms.
7,222 Motor-propelled vehicles—F. R. Simms.
7,318 Vacuum brake apparatus for railway vehicles—E. S. Luard.
7,331 Brake-operating mechanism of tramway vehicles—E. Hatton.
7,353 Method of fixing wheels on axles of motor wagons—H. E. Buck.
7,366 Electrical transmission for automobile vehicles—Daimler Company, Limited, F. W. Lanchester, and J. L. Milligan.
7,371 Means for connecting automatic and non-automatic couplings on railway vehicles—H. Rose.
7,413 Ventilators for tramcars, motor omnibuses, railway trains, etc.—W. Ash.
7,446 Reversing gear for locomotives—W. F. J. Casey and G. Cavin.
7,454 Construction of rail-road—A. A. Bhisey.
7,498 Electric conductor rail anchor clip—H. Scott.
7,507 Railway vehicle braking arrangements—Both and Tilman G.m.b.H.
7,517 Electrically-operated railway signals—A. Enefer.
7,527 Apparatus for automatically stopping railway trains—S. Radi.
7,555 Apparatus for controlling and stopping trains independently of drivers—A. F. Bound and W. Rowland.
7,560 Motor road vehicles—A. W. Wall.
7,587, 7,588, 7,589 Automatic car couplers—J. Willison.
7,650 Railway signalling—W. R. Sykes Interlocking Signal Company, Limited, and R. W. Tarrant.
7,680 Points or switches for tramways, railways, etc.—Edgar Allen and Company, Limited, and C. Piggott.
7,684 Railway signalling and control—A. E. Howarth.

Specifications Published.

1914.

2,751 Steam superheaters—Willoughby and Willoughby.
8,832 Vehicle wheels—Dunlop Rubber Company and Wright.
9,098 Chain grate stokers—Babcock and Wilcox, Limited.
17,197 Route indicators—Burgess and Oakley.

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3,068 Driving and braking mechanism for automobile vehicles—Soc. Ch. Blum et Cie.
9,203 Fuel economisers—Park.
10,720 Steam superheaters for locomotive boilers—Robinson.
11,795 Steam superheaters—Bolton and Gray.
11,915 Railway signalling apparatus—O'Donnell.
12,961 Train stopping apparatus—Northup, Overacker, and Marklie.
13,141 Air supply to mechanical stokers—Wood.
15,700 High-speed railway system with vehicles running in a vacuum—Oates.
2,160 Device for automatically coupling air or steam conduit lines between railway cars—Videbak and Pallesen.
9,454 Driving of road or rail vehicles—Thomas Transmission, Limited, and Thomas.
9,537 Car trucks—Adams.
9,582 Electric railway systems—Stuart.
9,730 } Car trucks—Adams.
9,731 }
9,856 Return circuits of electric railways and tramways—British Thomson-Houston Company and Carter.
10,016 Arrangement of audible signals for tramcars, etc.—Farrall.
10,532 Alternating current track signalling—Peter.
11,237 Compressed air brakes—Chapsal and Saillot.
11,804 Automatic block signals for railways for absolute or permissive working—Wight.
13,406 Motor trucks—Bernheimer.
17,220 Water tube boilers—Noble.
10,521 Mechanically-propelled road vehicles—Andersen.
10,531 Electric motor control systems—British Thomson-Houston Company (*General Electric Company*).
10,533 Alternating current track signalling—Peter.
10,534 Electrically-operated signal actuating mechanism—Peter.
10,938 Electrical control and operation of railway points—Alexander (*Union Switch and Signal Company*).
21,736 Construction of railway and tramway vehicles—Smith.
22,596 Rail joints—Smith.

1915.

3,472 Brakes for motor vehicles—Mellor and Morton.
3,311 Steam generators for motor road vehicles—Clarkson.

BRITISH ELECTRICAL FEDERATION RECORD.

We have received No. 5 of the *British Electrical Federation Mutual Aid Fund Record*, the contents of which are deeply interesting. Unhappily, the list of the men who have given their lives for their country is increased by fifteen names. The larger part of the *Record* is filled with letters from the employees of the Federation doing duty at the front. Every man shows that spirit of calm courage and cheerful endurance under the unprecedented conditions of modern warfare which has become a recognised characteristic of the British soldier. That this greatness of soul has animated a whole army tends to induce a feeling of comfortable acquiescence in it as a commonplace, but it is nevertheless a phenomenon which cannot sufficiently be admired.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.		1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
		May 2.	May 9.	May 16.	May 23.		May 1.	May 8.	May 15.	May 22.		Wks.	1915.	Increase or Decrease.
		£	£	£	£		£	£	£	£			£	£
Anglo-Argentine		50.179	58.772	52.697	55.368	...	50.995	54.791	53.137	53.193	...	20	1,028.517	– 98,198
Auckland		(28 days)	22.268	...	...	...	(28 days)	20.447	...	...	...	44½	227.598	+ 1.206
Burma	Rs.	4.152	4.429	4.053	4.175	...	3.707	3.641	3.496	3.827	...	...	...	– 40.912
Calcutta	Rs.	65.680	67.986	62.722	63.910	...	60.267	61.079	62.152	65.082	...	21	1,329.063	– 82.991
Hong Kong	$	10.369	10.741	10.647	10.789	...	10.199	10.486	8.911	10.312	...	21	221.985	– 23.210
Madras	Rs.	...	(2 weeks)	29.191	...	...	...	(2 weeks)	29.026	...	...	19	257.087	– 5.131

Companies Issuing Monthly Statements.

		1913	1914.					1914.	1915.					Wks.	AGGREGATE.	
		Dec.	Jan.	Feb.	March.	April.	May.	Dec.	Jan.	Feb.	March.	April.	May.		1915.	+ or –.
		£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street	Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Brazilian Traction	Mlrs	6,142.209	6,194.227	5785027	6153984	...	...	6,010.490	5,996,190	5797500	6294910	...	...	13	18.088,600	– 44,638
Brisbane		29.145	28.330	25.260	28.325	28.610	...	30.890	29.620	26.590	30.740	29.890	...	17	116.840	+ 6,315
British Columbia	$	793.219	777,102	704,003	717.251	...	...	674.063	640,495	558.512	557,135	...	...	39	5,755,041	– 997,041
Buenos Aires Pt. & C.		...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze		...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town		14.147	14.646	13.342	13.922	13.408	...	15.869	15.660	13.924	15.829	14.512	...	17	59.925	+ 4,607
Carthagena & Herrerias		2.698	2.776	2.919	2.425	2.069	2.202	1.255	904	1.822	2.436	1.496	1.931	21	8.589	+ 4,607
Cordoba		12.863	...	...	...	...	...	12,119	...	...	...	...	...	39	119.457	– 845
East India		2.046	1.938	1.701	1.884	1.837	1.885	1.839	1.914	1.649	1.846	...	2.119	43	19.359	+ 235
Kalgoorlie		2.907	2.340	2.169	2.476	...	...	2.905	2.372	2.352	2.638	...	...	13	7.362	+ 377
La Plata		5.505	5.296	4.766	5.178	4.716	4.727	4.452	4.540	4.016	4.582	4.269	4.489	21	21.896	– 2,787
Lima		38.091	37.870	33.779	34.665	34.153	...	32.112	33.042	30.173	34.180	31.615	...	17	129.010	– 11.457
Manila	$	154,000	137.000	153.300	137.200	134.300	...	132,500	127.500	123.000	119,984	117,450	...	17	488.616	– 74,042
Melbourne		...	68,500	64,000	63,000	...	...	...	62,729	59,086	64,506	...	...	13	186,321	– 9,179
Mexico	$	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo		33.310	38.256	35.805	32.630	29.650	29,016	28.605	32.443	30.007	29.716	26.786	27,771	30	202.426	– 26.771
Port Elizabeth		4.367	4.830	3.510	4.535	3.758	...	3.986	4.102	3.149	3.346	3.371	...	17	13.968	– 2.665
Puebla	$	65.600	...	...	...	...	...	40.000	...	...	...	...	...	52	669,500	– 44.500
Rangoon		5.424	5.163	5.009	6.475	5.367	...	4.459	4.689	4.991	5.217	4.964	...	17	19.861	– 2.153
Toronto	$	...	847,945	777,683	836,328	...	...	...	843,351	767,326	820,750	...	...	13	2.431,427	– 30.529
Winnipeg	$	379,863	382,670	350,977	347,812	...	...	368,400	350,681	314,658	303,209	...	...	13	968,549	– 112.912

(*Continued on page 434*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	May 2	May 9	May 16	May 23	May 1	May 8	May 15	May 22	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1,596	1,751	1,626	1,752	1,564	1,794	1,638	1,613	51	83,580	+ 2,145
Accrington Corporation	...	...	...	...	...	...	...	...	—	—	—
Ayr Corporation	304	275	291	386	308	292	340	333	52	17,160	− 1,126
Bath Electric	*	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation	1,443	1,247	1,259	1,264	1,326	1,315	1,327	1,368	7½	10,004	− 108
Birmingham Corporation	12,421	12,349	12,225	12,711	12,761	12,934	12,939	12,995	8	96,050	− 411
Blackburn Corporation	1,319	1,273	1,179	1,429	1,172	1,187	1,252	1,240	8	9,812	− 1,139
Blackpool and Fleetwood	578	438	404	505	393	438	369	416	20	7,296	− 1,233
Blackpool Corporation	1,125	814	869	860	660	1,113	699	699	8	7,089	− 2,245
Bolton Corporation	2,818	2,697	2,907	2,756	2,666	2,735	2,721	1,711	8	19,562	− 3,035
Bournemouth Corporation	1,853	1,775	2,011	1,825	1,988	2,010	1,861	2,648	8	17,532	+ 997
Bradford Corporation	6,368	5,859	6,325	6,099	6,363	6,131	6,865	6,346	8	48,474	− 696
Brighton Corporation	996	899	1,039	1,077	971	999	985	1,067	7½	7,571	− 692
Bristol	8,539	8,155	8,043	9,177	9,038	9,357	9,087	9,912	20½	176,623	+ 15,981
Burnley Corporation	1,838	1,606	1,654	1,647	1,477	1,555	1,564	1,525	8	12,559	− 2,708
Burton-on-Trent Corporation	285	296	290	302	280	281	284	286	8	2,128	− 195
Bury Corporation	1,303	1,291	1,395	1,322	1,334	1,356	1,294	1,328	7½	10,311	− 710
Cardiff Corporation	2,733	2,734	2,744	2,785	2,556	2,631	2,625	2,707	7	19,374	− 2,276
Chatham and District	917	870	836	956	1,042	1,172	1,128	1,129	20	20,628	+ 3,139
Chesterfield Corporation	386	326	251	270	250	265	250	250	7	1,805	− 351
Colne Corporation	296	262	290	192	232	241	241	251	—	—	—
Cork Electric	544	484	499	591	523	521	563	497	20	9,236	− 309
Croydon Corporation	1,788	1,695	1,604	1,875	1,702	1,845	1,816	1,680	7	13,130	− 434
Darlington Corporation	244	246	259	255	241	240	256	256	7½	1,890	− 80
Derby Corporation	1,049	947	999	1,022	959	1,000	1,021	1,045	7½	7,640	− 288
Dover Corporation	233	209	206	242	264	297	288	301	7	2,152	+ 333
Dublin and Lucan	151	135	136	170	161	142	150	139	20	2,615	+ 42
Dublin United	5,926	5,878	5,704	6,409	6,369	6,141	6,035	5,867	20	116,397	+ 5,548
Dundee City	1,329	1,329	1,272	...	1,284	1,277	1,302	...	52	66,584	− 1,170
East Ham Corporation	1,026	1,013	977	1,064	1,309	1,349	1,343	1,214	7½	9,847	+ 2,050
Exeter Corporation	351	323	324	384	356	365	363	354	7	2,610	—
Gearless Motor 'Buses	*	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	21,600	21,263	22,357	22,368	22,426	22,179	22,014	22,814	50	1,041,918	− 7,753
Glossop (Urban Elec. Supply Co.)	126	129	128	124	118	137	123	126	21	2,379	− 199
Halifax Corporation	2,114	2,003	1,885	2,208	1,988	2,108	2,136	2,113	7	14,955	− 560
Hastings and District	994	874	827	997	872	902	902	864	20	15,783	− 718
Huddersfield Corporation	2,199	2,200	2,193	2,268	2,480	2,560	2,542	2,525	8	19,481	+ 1,507
Hull Corporation	3,069	3,143	3,054	3,044	2,997	3,027	2,881	3,081	7	22,714	− 1,471
Ilford U.D. Council	488	472	458	497	610	641	633	632	7	4,711	+ 958
Ilkeston Corporation	126	122	136	123	121	126	125	165	8	1,018	− 40
Ipswich Corporation	428	417	448	574	422	441	427	511	7	3,342	− 130
Isle of Thanet	462	442	465	537	310	335	323	457	33	10,171	− 2,716
Kilmarnock Corporation	166	174	157	176	164	165	211	170	52	8,353	− 706
Lanarkshire	1,942	1,912	1,849	2,129	1,870	1,855	1,832	2,001	20	35,817	− 2,129
Lancashire United	1,683	1,610	1,567	1,851	1,629	1,640	1,690	1,703	20	31,555	− 573
Leeds City	8,406	8,067	8,239	8,513	8,401	8,525	8,593	8,757	8	64,510	+ 971
Leicester Corporation	2,903	3,030	2,882	3,018	2,939	3,097	3,013	3,066	21	58,430	+ 139
Leith Corporation	715	717	723	799	706	716	717	787	52	36,480	− 263
Leyton U. D. Council	1,353	1,339	1,283	1,468	1,516	1,620	1,655	1,344	7	11,211	+ 1,275
Liverpool Corporation	13,021	13,143	13,116	13,773	13,122	13,340	13,334	13,402	20	258,057	− 4,967
Llandudno and Colwyn Bay	239	227	230	236	308	317	305	316	24	5,992	+ 948
London County Council	44,148	43,642	42,779	...	47,977	50,155	50,891	...	6	297,212	+ 32,129
London General Omnibus	*	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	169	168	163	185	154	156	152	160	33	5,451	− 612
Maidstone Corporation	203	194	189	204	178	205	198	198	7	1,553	− 103
Manchester Corporation	17,935	17,710	17,614	18,343	17,326	17,777	17,595	17,759	7	131,165	− 3,405
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	217	195	202	220	184	170	183	180	7½	1,393	− 272
Newcastle-on-Tyne Corporation	5,023	5,089	5,035	5,114	5,944	6,019	6,092	6,322	7	45,293	+ 5,542
Newport (Mon.) Corporation	774	803	787	825	814	804	806	835	8	6,020	− 365
New St. Helens and District	779	790	781	961	957	902	938	895	46	42,450	+ 4,408
Northampton Corporation	570	597	536	616	701	804	731	731	7	5,190	+ 778
Nottingham Corporation	3,382	3,412	3,324	3,521	3,437	3,510	3,539	3,454	7	25,116	− 491
Oldham Corporation	2,236	2,212	2,381	2,231	2,291	2,244	2,223	2,387	9	19,283	− 1,090
Portsmouth Corporation	2,158	2,037	2,049	2,365	2,400	2,501	2,451	2,474	8	18,542	—
Preston Corporation	913	878	818	884	910	922	914	898	7	6,433	− 633
Provincial	1,883	1,818	1,870	1,983	2,077	2,193	2,152	2,182	32	65,653	+ 6,496
Reading Corporation	698	673	667	758	710	751	777	748	7	5,320	+ 166
Rhondda Tramways	1,211	1,230	1,129	1,235	1,110	1,178	1,162	1,115	20	22,707	− 1,716
Rochdale Corporation	1,602	1,573	1,585	1,659	1,593	1,698	1,619	1,682	7½	12,587	− 313
Rotherham Corporation	939	961	1,031	875	1,044	1,023	1,056	1,483	8	8,818	+ 1,031
Salford Corporation	4,992	4,883	5,333	5,034	4,996	5,108	4,986	5,510	7½	39,397	− 545
Sheffield Corporation	7,668	7,649	7,875	7,740	8,494	8,449	8,437	8,650	8½	70,815	+ 3,936
Southampton Corporation	1,304	1,274	1,291	1,379	1,324	1,383	1,446	1,408	7	9,698	+ 150
Southend-on-Sea Corporation	904	846	791	912	684	777	887	759	7	5,687	− 1,102
South Metropolitan Tramways	*	...	...	...	...	...	...	...	—	—	—
South Shields Corporation	723	718	741	755	720	723	735	770	7½	5,649	− 61
Sunderland Corporation	1,366	1,363	1,410	1,463	1,369	1,376	1,426	1,460	8	10,759	− 346
Sunderland District	594	558	539	612	591	574	546	550	29	15,523	− 1,168
Swindon Corporation	169	159	155	183	172	197	196	191	7	1,323	+ 78
Torquay Tramways	589	479	487	583	570	528	536	492	20	9,378	− 268
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	525	512	507	575	562	570	582	614	20	10,559	+ 99
Wallasey Corporation	1,223	1,238	1,209	1,300	1,177	1,212	1,164	1,220	7½	8,913	− 811
Walsall Corporation	607	614	606	628	678	704	705	717	21	13,756	+ 925
Walthamstow U.D. Council	809	738	741	864	804	872	859	838	8	6,420	+ 220
Warrington Corporation	427	439	426	440	421	438	443	444	7	3,104	− 56
West Ham Corporation	2,833	2,780	2,711	2,943	2,966	3,186	3,243	2,932	7	22,074	+ 1,318
Wigan Corporation	1,428	1,488	1,469	1,583	1,439	1,469	1,450	1,583	7	10,741	− 511
Wolverhampton Corporation	1,020	999	1,059	1,016	1,080	1,037	1,020	1,580	8	8,968	+ 321
Yorkshire (West Riding)	1,361	1,356	1,613	1,395	1,534	1,646	1,452	1,583	21	31,212	+ 1,159

TRAFFIC RETURNS SUSPENDED.*

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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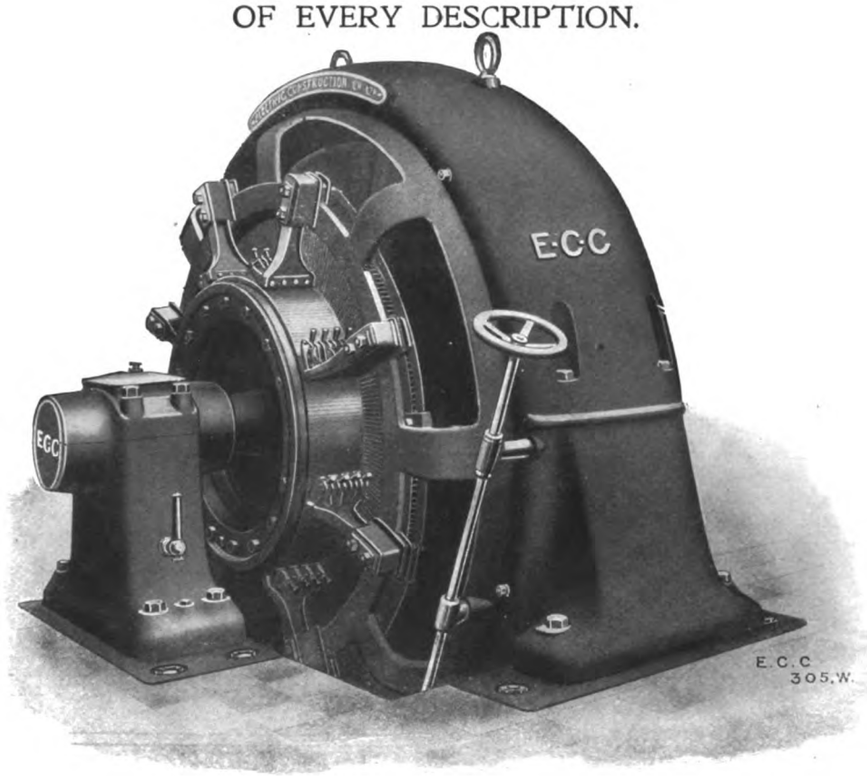

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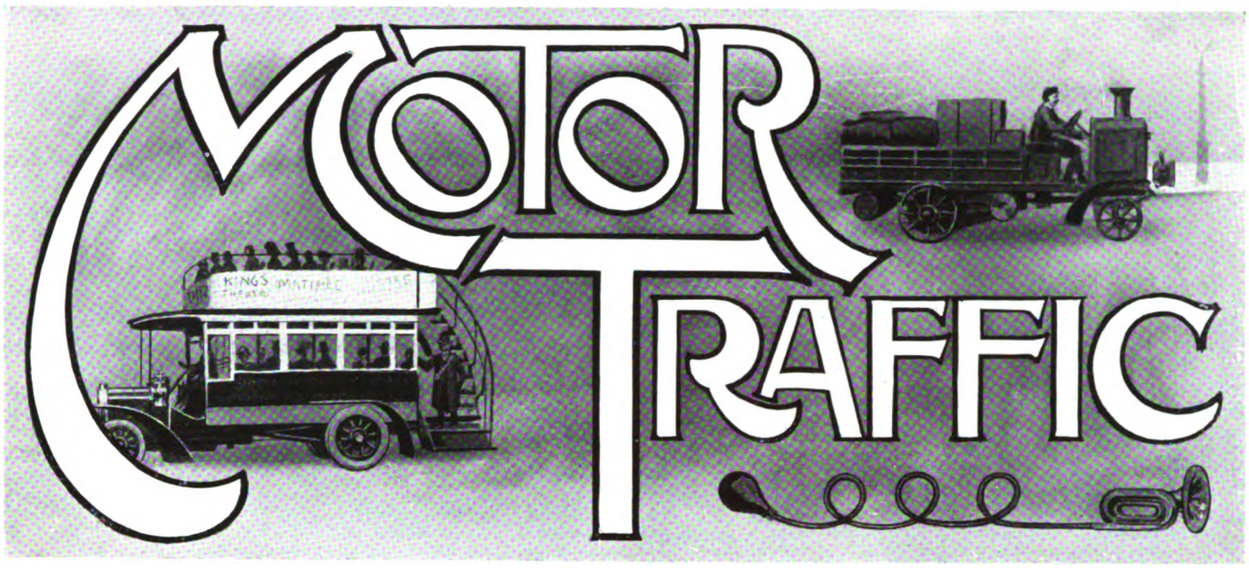

A position of exceptional difficulty for members of the motor manufacturing trade is evolved by the terms of the contracts or agreements made in the early stages of the war between the manufacturers and the War Department. In those days firms were perhaps almost too willing to become Government contractors. In a sense this, of course, is impossible, inasmuch as it is the bounden duty of all of us to do everything we can to help to bring the war to a successful conclusion ; but the fact is that, in their anxiety to get the work, the motor manufacturers did not look far enough ahead and realise the necessary consequences of the obligations which they were incurring. Most of the firms concerned imagined that the demands of the War Office would only last a few months ; some expected to be freed before the beginning of the present year ; but instead new legislation has been introduced bringing the manufacturers concerned much more directly under the control of the War Department. It is now no longer a matter of consenting to do certain things, but rather of being compelled to do them. Prolongation of Government work has, of course, involved the maintenance of raw supplies. This has become more and more difficult, and has necessitated looking ahead to the extent of at least nine months, and in some cases probably a year. The stocks thus laid in are specifically suited for the manufacture of the particular types of vehicle selected for Government work, and the great majority of them could not possibly be utilised for other purposes. This is where the difficulty comes in. The War Department has the right to reduce its orders at three weeks' notice, and to discontinue them entirely at six weeks' notice. Were this right exercised, all the manufacturers involved would be left with a stock representing approximately the concentration of their whole output for nine months on lorries of subvention or similar type. This stock would have been laid in at war prices, but it would be necessary to sell the complete vehicles subsequently manufactured at ordinary competitive prices. There would be a strong tendency towards price cutting as a natural consequence of the situation of manufacturers, all of them equally desirous of disposing of large quantities of machines of almost identical carrying capacity. One may well imagine that if these possibilities become facts, many firms will suffer serious embarrassment. The only possible solution appears to lie in an alteration of existing agreements. The difficulty would at least to an extent be overcome if the War Department undertook to give six months' notice of the cessation or reduction of orders. In any case the position at the conclusion of the war will be bad enough. Manufacturers will have to face the competition in the market of their own second-hand stuff, and possibly even of considerable numbers of new vehicles purchased, but not put into service, by Government. The whole matter is one which seems to demand the urgent and serious attention of the Board of Trade as the department of the Government specifically interested in the maintenance of British industry, and the strengthening of the industrial links which bind the mother country to the Empire overseas.

Immediate need exists for all who are interested in automobile vehicles to render further service to the King and the Empire, and a great deal of persistence would seem to be necessary if the urgency of the need is to secure due appreciation. Members of two national motoring organisations were recently circularised with a view to securing from among their employees further recruits for the transport service on the Continent, but the response did not prove all that could be desired. Under these circumstances an appeal might be made to owners of commercial and industrial vehicles to facilitate enlistment by their drivers as soon as steps have been taken to secure and train other men to take their places. We are aware that owners and men connected with all classes of power-driven vehicles have already made great sacrifices ; but many of them have it in their power to release drivers whose skill is imperatively required at the present time for army service. For months past men have been enlisted for the transport branch of the Army Service Corps without possessing a knowledge of automobile vehicles, and they have subsequently had to be trained. This work has been undertaken for the War Office by the London General Omnibus Company, whose officers and employees had already nobly responded to the country's call. The company's ordinary school has been closed, and the new work of tuition is carried out in extensive rural quarters. There is no lack of recruits to undergo the training, which is very thorough, and embraces a certain amount of mechanical knowledge, while the remuneration conveys full recognition of the responsible and dangerous work which these drivers perform in the war area. It is obvious, however, that economy in time and money of enormous importance would be effected if further supplies of men already trained were made available.

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MOTOR TRAFFIC.

Months ago the Commercial Motor Users' Association (Incorporated) raised the question of the training of more men as drivers for war work. In view of the fact that the association has for its chairman Colonel R. E. Crompton, C.B., who directed the organisation of mechanical transport during the South African conflict, and that one of the vice-chairmen is Major-General Long, Director of Movements and Transport, War Office, it must be conceded that the action of the association was significant and merited attention. Moreover, upon the committee there were 11 military officers connected with mechanical traction, either in an official or civil capacity, all of whom are now with the troops. Lack of funds prevented the association undertaking the establishment of a school, but it was able to direct applicants for tuition to reliable private teachers. This in itself is an important work, when one remembers the trouble occasioned by unsatisfactory schools in the early years of the private car. The association's secretary, when recently informed by the present writer that the War Office had entrusted the work of training transport recruits to the London General Omnibus Company, observed that the task could not have been placed in better hands.

* * * * * *

Less has been said of the work of the Commercial Motor Users' Association in connection with the war than of the valuable efforts of the automobile clubs, but the association's records show that it has performed work of the utmost value to the authorities and to the nation, apart from services ordinarily rendered to its members. For the Mechanical Transport Committee of the War Office the association prepared a detailed list of owners of vehicles available for military work, with full particulars of each vehicle, arranged in counties, under varying load capacities. A list of drivers available for military service was compiled giving full particulars of the qualifications, arranged in counties, under various headings. A number of lorry drivers, fitters, and turners were obtained for the East Anglian Transport and Supply Column; 50 such men were secured for the 2nd London Territorial A.S.C.; and a considerable number for the Royal Naval Division. Assistance was given to the London Recruiting Headquarters by the preparation of a list of petrol and steam wagon drivers, fitters, turners, and blacksmiths available for active service, while for the War Office was prepared a detailed list of steam wagon owners, drivers, mechanics, boilermakers, enginesmiths, and wheelers, with full particulars of their qualifications. Arrangements were made for a number of motor vans to be placed at the disposal of the Local Government Board for the distribution of the Christmas gifts from America for the Belgian refugees. In addition, the officers of the C.M.U.A. have undertaken the control and manning of the mechanical transport of the City of London National Guard, Colonel Crompton being hon. commandant, Mr. Shrapnell Smith commandant, and Mr. Bristow adjutant. A number of the members of the C.M.U.A. Committee serve on committees concerned with traction at the War Office. At the outset of the war Colonel H. C. L. Holden, C.B., R.E., came from retirement and took up the duties of Director of Military Transport. Colonel Holden has been one of the most active members of the R.A.C., and this year he had agreed to undertake the duties of President of the Institution of Automobile Engineers. The latest service rendered by the C.M.U.A. is to be seen in the issue of copies of the "Sternol" pocket motor dictionary for the use of drivers on service. This little work contains 500 references to the construction and running of a motor vehicle, and a further supply has been forwarded to France at the request of the Director of Transport.

The undoubted connection between the number of street accidents—fatal and otherwise—and the darkened condition of the streets necessitated by the possibility of aerial raids, is proved very conclusively by evidence set forth in the recently published report of Dr. Waldo, Coroner for the City of London and the Borough of Southwark. In the district with which he is directly concerned, Dr. Waldo reports that forty-six fatal street accidents took place during the year 1914. Of these, seven occurred in the first quarter, ten in the second, nine in the third, and no less than twenty-one in the fourth period, during which the regulations requiring the streets to be darkened were enforced. Of these twenty-one fatal accidents, only four occurred before lighting-up time and seventeen after, and the evidence in the majority of these seventeen cases pointed strongly to the want of light being a prominent factor in bringing about the accident. In addition to tabulating his own figures, Dr. Waldo sets forth the figures for the whole of the Metropolitan police area and of the City of London. During the last three months of 1914 there were no less than 236 accidents. This number exceeds by 78 the number for the corresponding months of 1913. The nearest figure to it is 179, which refers to the third quarter of 1914. The second and third quarters might reasonably be expected to show lower figures than the first and fourth, but the figures for 1913 do not prove this to be the case. The lowest figure for any quarter in the two years was for the first quarter of 1914, when there were 117 fatalities. The fact that this number was practically doubled in the last quarter can hardly be attributed to any other cause than the darkened streets. It would be absurd to endeavour to argue from these figures that the darkening of the London streets is a precaution which does more harm than good. No such contention could be put forward without very much more complete information than is available to the public. The point, however, is that in all cities in which restrictions of lighting are contemplated, those responsible should recognise that it is now proved beyond doubt that such restrictions lead to a serious increase in the number of street accidents, fatal and otherwise, and this despite the equally certain fact that the darkening of the streets interferes with trade, and restricts the use of vehicles—more particularly those that are mechanically propelled. In all such cases there is a tendency for those responsible to consider merely the one danger which they are required to meet at the moment, and to ignore the possibility that, while increasing safety in some respects, they are at the same time increasing danger in others. What is needed is some scheme which, while not ignoring the dangers of a raid, is equally careful to avoid panic measures which unnecessarily injure trade by restricting the delivery of commodities and endanger the lives of the public.

Conveyance of Wounded Soldiers.—Birmingham Council on June 1 purchased an additional motor ambulance at a cost of £630 for the conveyance to hospital of wounded soldiers coming into the city.

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MOTOR TRAFFIC.

SOME RECENT DEVELOPMENTS IN COMMERCIAL MOTOR-VEHICLES.*

By Thomas Clarkson, M Inst.C.E.

During the period which has elapsed since the subject of motor vehicles was last reviewed before the Institution, remarkable developments have taken place in this department of engineering, not only in regard to the quality of the vehicles, but also in the magnitude of their operations for the transport of passengers and merchandise. The period reviewed in this paper has witnessed the evolution of the motor omnibus as it exists to-day. This alone may be regarded as an engineering achievement of no small magnitude, which is revolutionising the passenger transport of London, and is calculated to have decisive influence in the readjustment of traffic facilities in other places, and in linking up parts of the country which are now served very inadequately, if at all, by railways.

Passenger Transport Facilities.

Greater facilities for the transport of passengers in cities are constantly in demand. Electric rail motors, both on the surface and underground, have met this demand to some extent; but the motor omnibus has already demonstrated its superiority over the rail car or tram. The main points in favour of the omnibus, as compared with the rail car, are its flexibility and independence of action. Flexibility is the dominant feature—flexibility of route as to deviations, extensions, and modifications according to traffic conditions, and also flexibility of control in traffic, especially in the matter of speed, so as to vary it promptly in response to traffic conditions. Complete flexibility is impossible in motors dependent upon an extraneous power station; the vehicles must be self-contained, and the power generated from within. The author regards flexibility as the key to the solution of the street traffic problem in cities.

Fig. 1 shows the remarkable growth of the number of motor omnibuses in London during recent years.

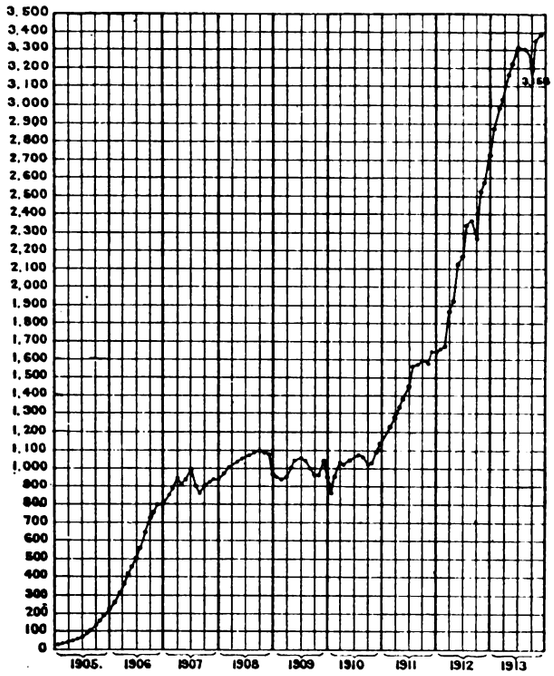

Fig. 1.—Motor Omnibus in London—1905-13.

By reason of the extent of the subject, it is scarcely possible within limits of a paper to do more than select for examination some typical examples of the commercial motors of the present day, and consider the suitability of various types of motor to the diverse conditions of industrial transport.

There are at present three methods of generating power for commercial motor transport, namely, by internal combustion engines, by steam engines, and by electric motors. Each of these methods has found a fairly clearly defined field of utility.

The internal combustion motor far outnumbers the other types of motor for net loads up to 3 tons. For heavier duty than this the steam motor continues to hold the field.

The rise in the price of petrol has directed attention to other liquid fuels for the internal combustion motor, and the steam motor using solid fuel is being adapted for loads less than 3 tons, with the object of checking the ever-growing demand for motor spirit.

The electric vehicle supplied with energy by a storage battery has made remarkably little progress in England. Since the promulgation of the new police regulations governing the construction of motor omnibuses for use in the Metropolis the electric omnibuses have been withdrawn from service, an important reason being the impracticability of bringing the weight of the vehicle within the prescribed limit. Under the new police rules the weight of the battery is included in the allowed weight of the vehicle, whereas formerly it was excluded.

Notwithstanding the decadence of the electric vehicle in this country, considerable developments have taken place in the construction and employment of commercial electric vehicles in the United States, where about 40,000 of them are now in use. The improvements made by Mr. Edison in the construction of storage batteries during the period under review have given a great impetus to the electric vehicle. Mr. Edison's improvements in batteries, and the pressing problem of obtaining cheap fuel for the internal combustion motor, bring the electric vehicle forward as a practical proposition; and an extensive revival of this type of motor may be expected in the near future for employment in town delivery work. The electric vehicle is very suitable for municipal ambulance duty.

The Internal Combustion Motor.

The internal combustion motor has been standardised to a considerable extent, and its efficiency as measured by the ton-mileage per gallon of fuel has been improved by closer attention to the conditions of high speeds of engine revolution, balance, reduction of reciprocating weights, proper areas of ingress and egress, and improved lubrication. The sleeve valve type of engine with either one or two sleeves is employed to some extent, but the majority of internal combustion engines are fitted with poppet valves. Thermo-siphon cooling is the rule, and high tension magneto ignition.

In the transmission of power to the road wheels there has been a great diminution in the use of chain drives in vehicles up to 3 tons in capacity; live axles are the rule, and are operated by either worm or bevel gearing, the differential gear being contained in the axle casing.

In the construction of the change-gear box, sliding gears are still generally used in commercial motors, but in the notable case of the "London General" omnibuses, a chain-drive gear box is employed with sliding clutches instead of sliding gears. This departure from standard practice appears to be due to the stringency of the police regulations with regard to noise, the chain-drive gear box being cheaper to maintain in the condition of quietness which is now insisted upon by the authorities. Figs. 2-6 illustrate the latest type of "General omnibus."

Another type of omnibus to which it is necessary to refer is known as the petrol-electric system. In this type the energy developed by the petrol engine is converted into electric current by a dynamo, and the current is then employed to propel the vehicle by means of one or more electric motors connected with the driving wheels.

The limits of this paper preclude a fuller reference to these interesting vehicles.

Fuel.

The petrol omnibus is confined to the employment of a volatile liquid fuel. The steam omnibus may use either liquid or solid fuels.

The relative cost of the two systems for fuel per mile is, of course, governed by the ratio between the cost per pound of fuel and the mileage per pound. Mileage per pound is an engineering question, but the price per gallon of liquid fuel appears to be governed not merely by conditions of supply and demand, but by other influences, at the discretion of the oil magnates. In view of this unsatisfactory situation, attempts have been made to use other fuels, and to adapt the steam omnibus for the use of solid fuel in such a manner as to preserve the clean and automatic conditions of liquid fuel combustion.

The fuel cost for a 3-ton petrol commercial vehicle, with petrol at 1s. 4d. per gallon, and at 8 miles per gallon, works out at 2d. per car-mile. The London petrol omnibus, which may be taken as equivalent to the 3-ton commercial vehicle, costs about 1d. per car-mile for fuel. This lower fuel cost, it should be explained, is not due to

* A Paper read and discussed at the Institution of Civil Engineers in conjunction with a Paper, "Comparative Economics of Tramways and Railless Electric Traction," by T. G. Gribble, M Inst.C.E. Reprinted by permission from the Proceedings of the Institution, volume 198, in which the Papers and the Report of the Discussion and Correspondence thereon are printed.

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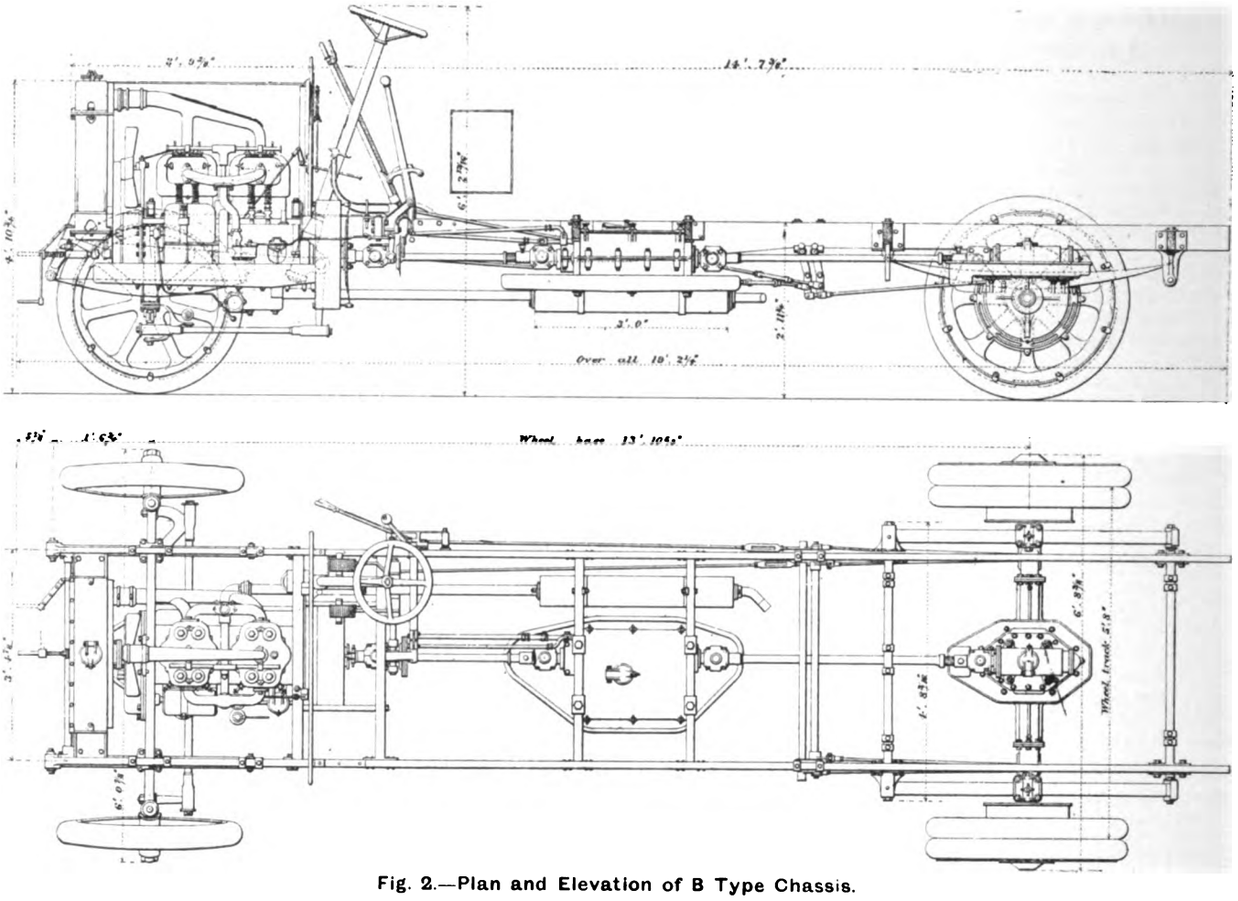

Fig. 2.—Plan and Elevation of B Type Chassis.

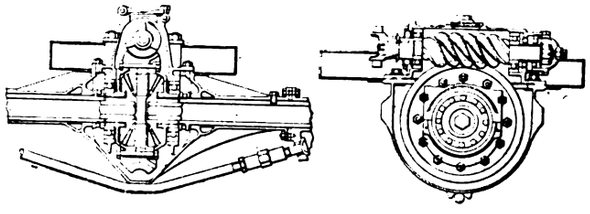

Fig. 3.—B Type Back Axle.

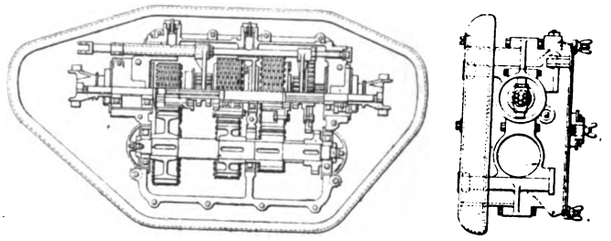

Fig. 5.—B Type Gear Box.

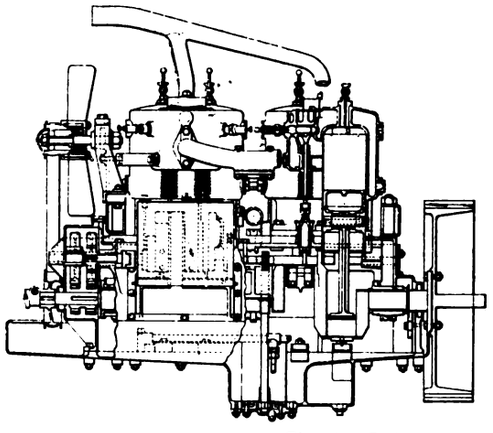

Fig. 4.—B Type Engine.

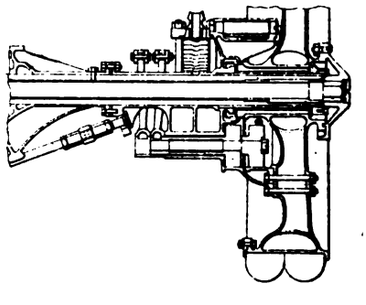

Fig. 6.—Back Wheels and Hub.

ARRANGEMENT OF B TYPE CHASSIS OF THE LONDON GENERAL OMNIBUS COMPANY.

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superior engine efficiency, but is the result of an exceptionally favourable contract for the purchase of petrol in very large quantities. The present cost of fuel for London petrol omnibuses is, therefore, abnormal from the point of view of the ordinary user of commercial petrol vehicles.

The steam omnibus at present costs for liquid fuel 1·875d. per mile, which is a little less than the cost of the ordinary petrol 3-ton vehicle. The steam omnibus, or 3-ton lorry, using coke, costs for fuel about 0·4d. per mile with coke at 19s. per ton. The significance of this economy, and the real value of an apparently small reduction in cost per mile, is indicated by the fact that ½d. per mile represents, approximately, £200,000 per annum on the cost of running London omnibuses.

With regard to the relative reliability of petrol and steam cars, it has been demonstrated conclusively that with either type of motor the mileage lost from mechanical causes is extremely small, even when performing a commercial duty involving an annual mileage of 30,000 miles and more per vehicle.

As regards the cost of mechanical up-keep, there does not appear to be any reason for a material difference between the two systems under this heading when they are run under similar conditions of management. Ball and roller bearings to wheel hubs have proved more expensive in maintenance than plain bearings, and their employment has not been justified on other grounds. The wheel-hubs of the steam omnibuses are therefore being fitted with two hardened bushes, having a floating bronze sleeve between them, as is the practice with petrol omnibuses.

The light 3-ton steam vehicle using coke as fuel may be regarded as combining the speed and handiness of the petrol motor, with a fuel cost equivalent to petrol at 4d. per gallon.

D type, and are held in circular bridles. The valves are of hard bronze, a material which works against a cast-iron port face with very slight lubrication, even with a steam temperature of 750° to 800°.

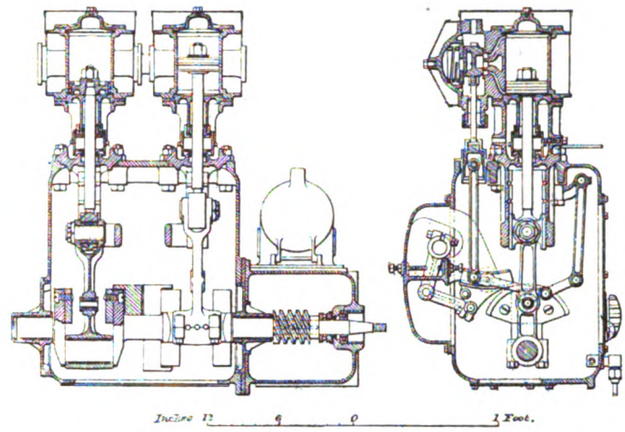

Fig. 8.—Arrangement of Two-Cylinder Engine.

The valve faces are dressed periodically with graphite, and a small feed of high-flash cylinder oil is forced into the steam pipe close to the engine.

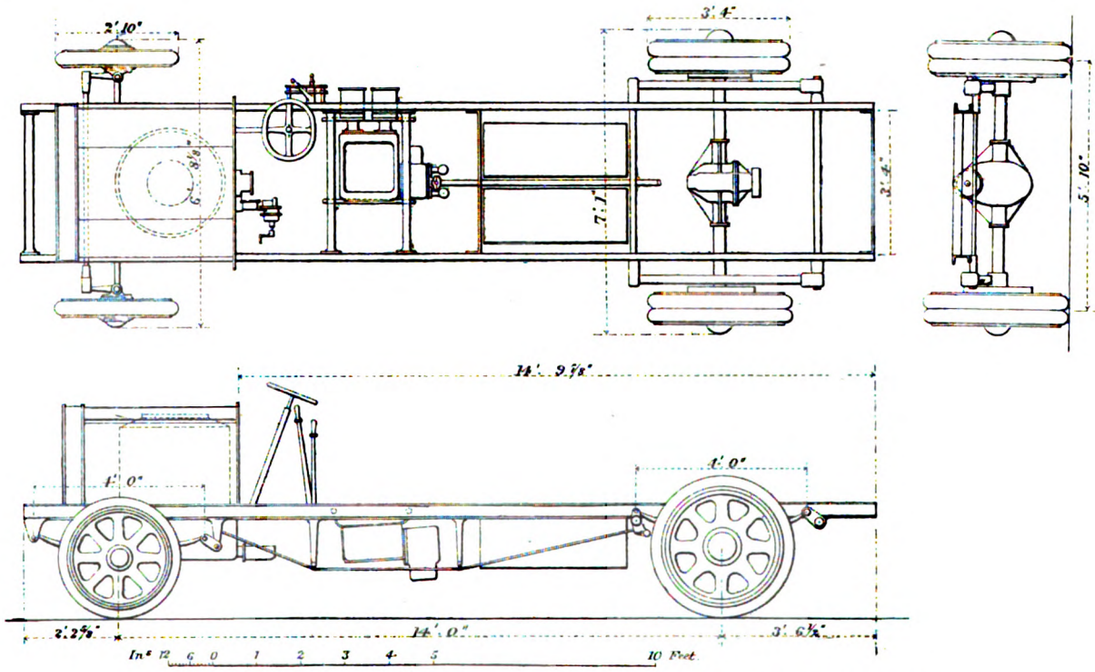

Fig. 7.—Outline of Type IV Chassis of National Steam Motor Omnibus.

Steam Omnibuses.

In both petrol and steam omnibuses a live axle is employed with a worm drive, the worm being above the axle. In the case of the steam omnibus, the worm is coupled directly to the engine crank shaft. Only one speed-reduction is made. There is no change-gear box in the steam omnibus, neither is any clutch employed. The engine is always directly coupled to the road wheels (Fig. 7). The ratio between crank shaft and rear axle is 1 to 6·2. The engine has two horizontal double-acting high-pressure cylinders, 4 inches by 4 inches. Joy gear is employed, with slide-valves, which are placed underneath the cylinders. This arrangement facilitates the escape of water, and renders the use of drain-cocks unnecessary.

The valve gear is enclosed in the crank case. Lubrication is effected by means of a rotary pump, which draws its supply from a sump in the base of the crank case. The slide valves are of the

Plain journal bearings have been found superior to either ball or roller bearings. Ball thrust bearings are still employed in connection with the worm drive which operates the pumps for fuel and water. Fig. 8 shows the general arrangement of the engine. It will be noted that the two pumps are actuated from eccentrics on a short transverse shaft, which carries a worm wheel engaging a hardened steel worm keyed on the crank shaft. The ratio between crank shaft and eccentric shaft is 1 to 6·6.

The pumps for fuel and water are identical in construction, and are therefore interchangeable. The eccentric which operates the plunger of the fuel pump has a shorter stroke than the one which operates the water pump. The construction of the pump valve box is shown in Fig. 9. The box is cast solid with the barrel of the pump, and the suction valve rests upon the base of the valve box. Immediately above the suction valve is placed a cage, which forms

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the seating of the delivery valve and also serves to limit the lift of the suction valve.

The delivery valve is identical and interchangeable with the suction valve, both being of the flat seated type, and the lift of the delivery valve is limited by a peg on the underside of the valve box cover. A steel bridle with one centre screw secures all the component parts of the valve box in position.

The pump plungers are not fitted with stuffing boxes, but instead have hydraulic joint rings of the hat type. These rings are made of a composite material, which resists the action of both kerosene and

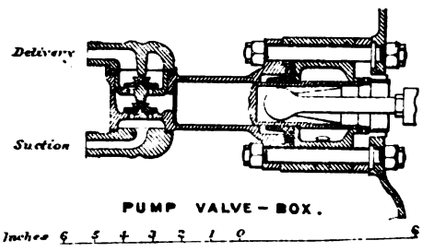


Fig. 9.—Pump Valve Box.

hot water. The same rings are thus interchangeable and suitable for both pumps.

Interchangeability, with the minimum number of parts for all purposes, is a point of the first importance in motor omnibus organisation.

The steam-generator is of the water-tube type. Boilers of the fire-tube, flash, and semi-flash types have been superseded by the water-tube boiler, which has proved more reliable under the severe conditions of motor-omnibus work. The form of generator which has been in successful use for the past five years is shown in Figure 10. It is forged from a solid piece of steel, and consists of a central drum, having on the outside several rows of generating-tubes, which are secured to the drum by expanding and bell-mouthing. Fig. 11 shows three stages of the manufacture of the boiler-drum. The generating-tubes are of horseshoe pattern and are slanted to assist circulation.

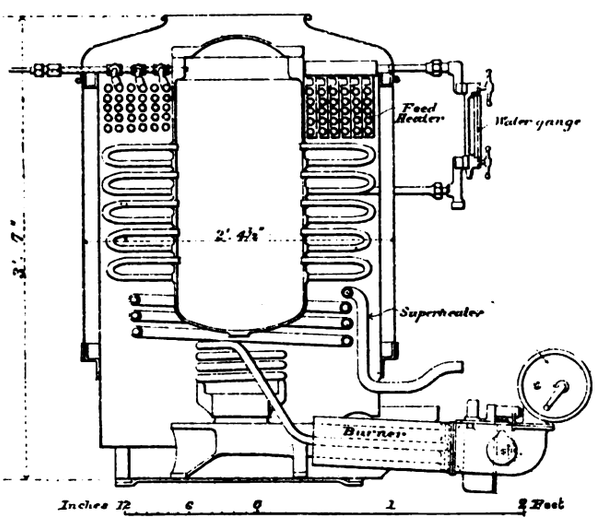


Fig. 10.—Arrangement of W.T. Boiler.

Around the drum, and above the generating-tubes, is fitted an economiser, through which the feed-water passes. The economiser is secured to and supported by three radial arms, which are bolted through the top of the shell. The outer ends of the supporting arms rest upon and are secured to the top ring of the case which encloses the boiler.

All the boiler-connections, with one exception, are made in the plane of the supporting arms, in order that they may pass out of the case immediately above the top ring, thus facilitating the removal of a boiler from its case. Boilers and cases are, of course, interchangeable. The case is of double sheet iron, and the intervening space is filled with magnesia insulation. The lower part of the case is lined with segmental fire-bricks.

Beneath the generating-tubes a superheating-coil is secured in a position to encircle the flame from the kerosene burner. The degree of superheat is regulated by the length of tube in the superheater in relation to the diameter of the superheating-coil, and its position relative to the flame.

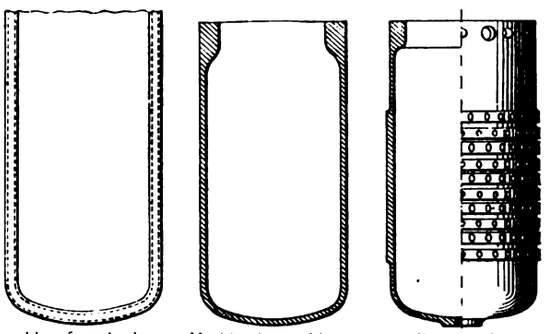
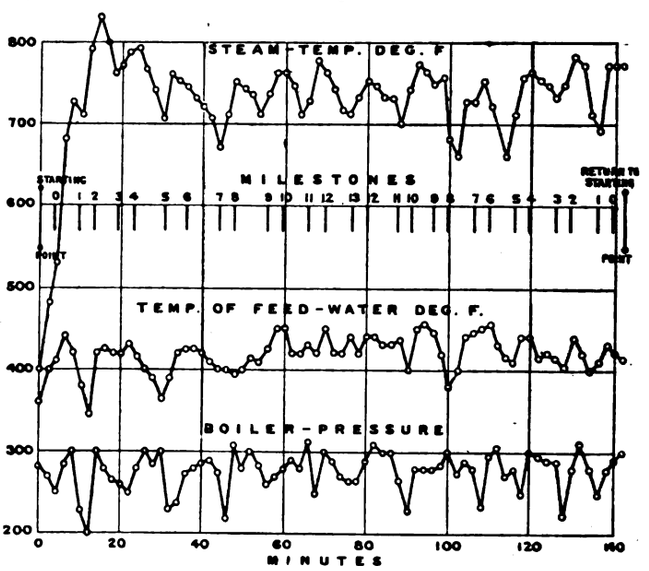

Roughly forged drum which is turned inside and out to the dotted lines.
Machine drum with open end upset to form a thick flange.
Finished drum (Half a section).

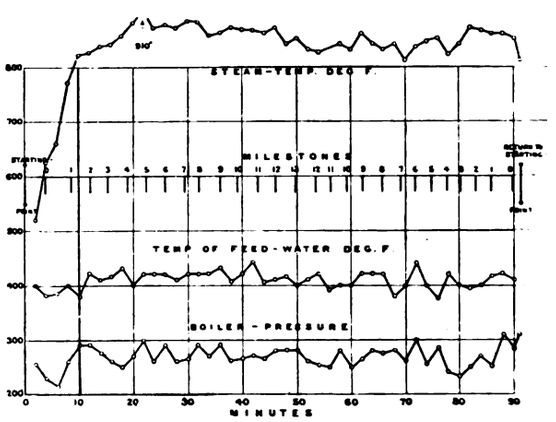
Fig. 11.—Boiler Drum.

The superheat temperature ranges from 750° F. to 800° F. On long non-stop runs the superheat is higher than when working in congested traffic. Figs. 12 and 13 give records of test runs for temperatures of superheat and feed-water. The temperature of the water is raised to



National Steam Car.—Standard London Omnibus (34 seats). Intermittent Test. Alternate miles at about 8 and 16 miles per hour. 5-second stop at each milestone.

Fig. 12.



National Steam Car.—Non-Stop Test at about 18 miles per hour.

Fig. 13.

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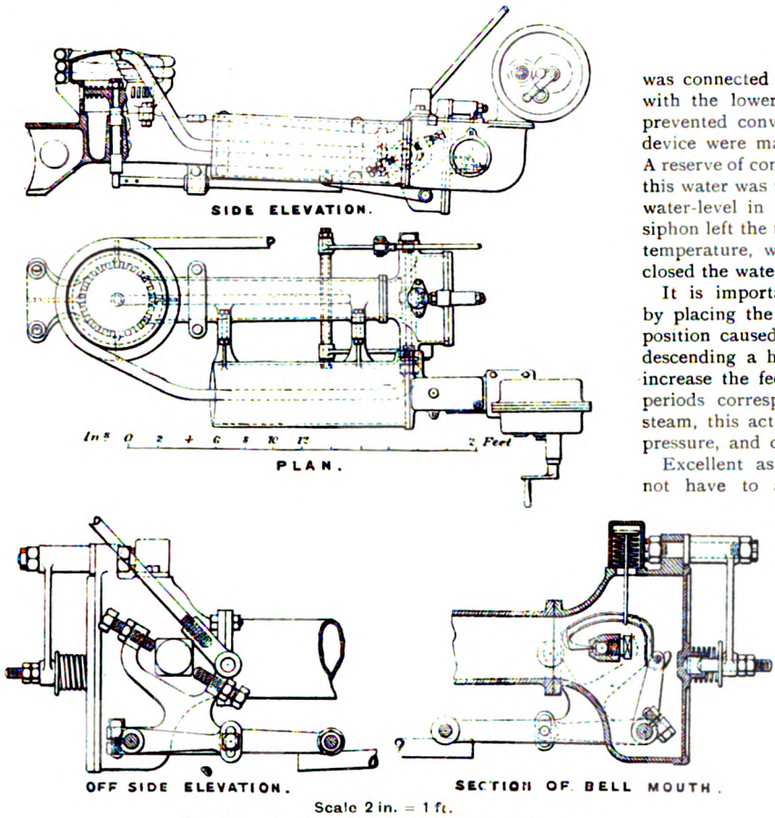
about 400° before it enters the boiler, this preliminary heating being obtained by the ultilisation of what would otherwise be waste products of combustion.

The water-supply tank contains on an average 15 to 20 gallons. The water in the tank is warmed to about 140° F. by exhaust steam before it enters the economiser.

The kerosene-oil burner is of the vaporiser type and is shown in Fig. 14. Oil is supplied to the burner at a pressure of 30 lbs. per square inch. The vaporising is done mainly by radiant heat. Actual flame-contact with the vaporiser is avoided as much as possible, as it would cause local heating and consequent cracking of the oil and deposition of carbon. It is desired merely to vaporise the oil without change in its chemical constitution, and for this a temperature of 600° to 700° F. is sufficient.

The vapour is allowed to escape from a regulated orifice at considerable velocity, thereby taking air by induction and forming a combustible mixture. The mixture is allowed to escape for combustion



Scale 2 in. = 1 ft.

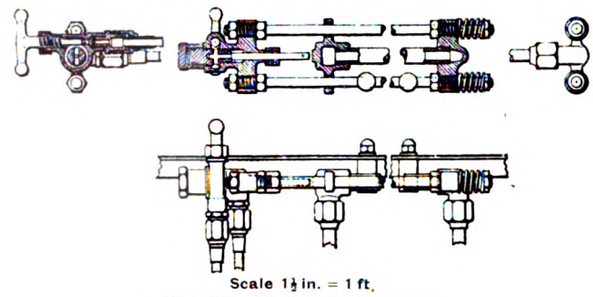
Fig. 14 – General Arrangement of Burner.

through ports in the burner-head which are controlled by a piston-valve. The movement of the piston-valve is synchronised with the regulation of the vapour-orifice. In this manner back-firing is prevented, and a suitable mixture of vapour and air—which means a suitable character of flame—can be obtained at any rate of combustion, from the maximum rate to the minimum, the latter being only sufficient to keep steam when the car is not running.

When starting the burner cold, the section of the vaporiser-tube nearest to the orifice is heated by an auxiliary flame obtained from an asbestos wick. A hand-fan supplies the necessary blast. The starter-flame also serves as an igniter for the main burner-flame.

The flame from the burner is directed upwards at an angle of 30° and forms a ring of flame which, after skimming the superheater, operates upon the generating-tubes. Steam is easily raised from cold water in 10 minutes. The working-pressure is 250 to 300 lb. per square inch. At the higher pressure a spring-loaded piston moves the burner-lever to the position of minimum flame. In addition to the automatic pressure-control, the burner is directly under the control of the driver. The boiler test-pressure is 1,000 lb. per square inch (cold water).

The water-level is indicated by a gauge of the reflex pattern, and the level is controlled from a by-pass on the pump delivery-pipe. The controlling-lever is situated immediately beneath the steering-wheel. Two or three years ago the cars were fitted with an automatic control for the water-feed in addition to the reflex gauge. This device is shown in Fig. 15. It consisted of a mild-steel tube placed horizontally outside the boiler at the water-level. One end of the tube



Scale 1½ in. = 1 ft.

Fig. 15.—Water Automatic.

was connected with the steam-space in the boiler, and the other end with the lower part of the boiler, through a cooling siphon which prevented convection circulation. The side rods of the controlling device were made of invar steel, which has practically no expansion. A reserve of comparatively cool water was entrapped in the siphon, and this water was raised into or withdrawn from the thermo-tube as the water-level in the boiler rose or fell. When the cool water from the siphon left the thermo-tube its place was taken by steam at the boiler temperature, which caused the tube to expand, and in doing so it closed the water by-pass, thereby increasing the feed to the boiler.

It is important to note that a distinct advantage was obtained by placing the thermostat across the rear side of the boiler, which position caused it, owing to the tilting of the car when ascending or descending a hill, to decrease the feed on a rising gradient and to increase the feed when the car was travelling down-hill. As these periods correspond respectively with greater and less demand for steam, this action of the thermostat assisted to equalise the steam-pressure, and conduced to good hill-climbing powers.

Excellent as the device is (and by its use drivers would usually not have to adjust the water feed once in a day's run), the inexorable conditions of motor omnibus service render paramount the claims of simplification and reduction in weight and in the number of parts.

Experience with this device illustrates the fact that if any part of a chassis can be eliminated it ought to be, because what is not there can never be misused, never gives trouble, costs nothing for maintenance, saves transport charges, and leaves more space for getting at things which are essential. This guiding principle has proved of great utility in the evolution of the motor omnibus, which the author believes has a more strenuous duty to perform than any other type of commercial motor.

The Illumination of Motor-Omnibuses.

Oil-lamps were discarded with the horse omnibus, and acetylene is now giving place to electric illumination, which is cleaner, and gives a better distribution of light. In some petrol omnibuses the lighting is obtained entirely from storage batteries. In others a smaller battery is used in combination with a dynamo and an automatic cut-out, which switches the dynamo on or off according as the speed is above or below what is requisite for excitation. This may be called the battery-dynamo system of omnibus lighting. Dynamos of special construction are employed, which give practically constant voltage at any speed of the armature from 500 to 2,000 revolutions per minute.

The chief drawback to the employment of batteries alone is that the illumination is comparatively feeble, owing to the limited weight of battery which is permissible, having regard to the police regulations as to weight. The battery-dynamo system gives better illumination, but is more expensive and complicated.

The battery-dynamo system, which was used for several years upon steam omnibuses, has been superseded by a lighting equipment consisting of a dynamo coupled directly to a small engine. No batteries are now used on steam omnibuses. The lighting engine (Fig. 16) has a pair of single-acting cylinders with cranks opposite, and one slide valve for both cylinders, which is operated through a rocking lever from a cam on the crank shaft. Automatic lubrication is provided. A steam pressure of about 70 lb. per square

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inch is found ample to provide abundant illumination for the whole of the omnibus, both inside and outside. The engine and dynamo run at 950 revolutions per minute, and the dynamo has an output of 14 amperes, 12 volts. Metallic filament lamps are used.

This equipment is the most satisfactory of any tried by the author. It is cheaper both to instal and to maintain, and there is a saving of about 100 lb. in weight as compared with the battery-dynamo system. The equipment is extremely simple, and runs with only slight attention. The effect of fluctuations in boiler pressure (which are inevitable in consequence of the variable demands for power, especially in congested traffic) is avoided by fitting a reducing-

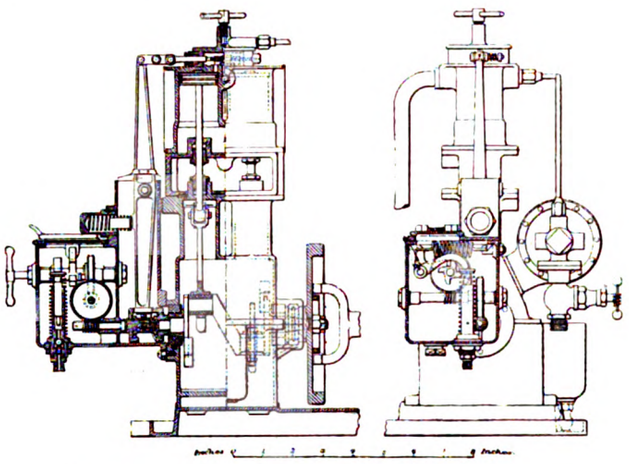
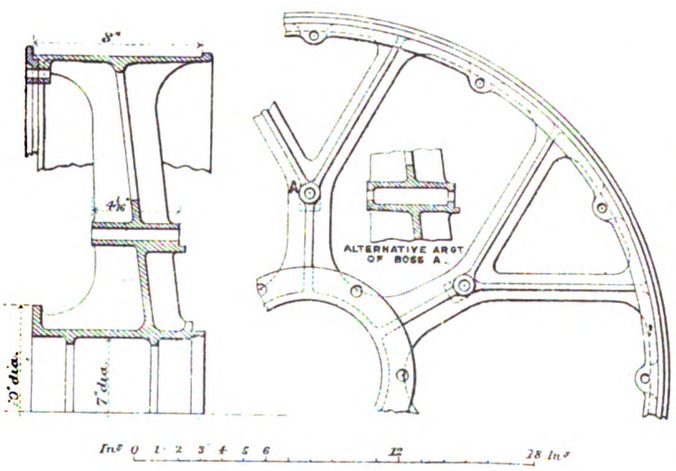


Fig. 16.—Arrangement of Electric Light Engine.

valve. This controls the pressure of the steam supplied to the lighting-engine, and maintains a practically constant voltage without any other governor, even with the boiler pressure varying between 200 and 350 lb. per square inch.

Wheels for Commercial Motors up to 3 tons in Capacity.

The wooden wheel is passing in favour of metal wheels, which are more durable and are better able to resist atmospheric influences. Cast steel wheels having spokes of cruciform section are extensively used. The **Y** spoke, or "spider" wheel (Fig. 17), in which each spoke branches into two, thereby giving double the number of supports to the rim, is largely used for rear wheels, which of course carry most of the load, in addition to the driving stresses. These



Scale.

Fig. 17.—Rear Wheel.

wheels are extensively employed on petrol omnibuses. Hollow-spoke cast wheels are also used; they have a better appearance, and are more easily cleaned than the "spider" wheels, but are somewhat heavier and more expensive to make. The drawback of cast wheels is inherent in the material and the method of manufacture. Variations in thickness and quality of the cast metal, and the possible presence of blow-holes, have to be provided for by adding to the weight. In most of the details of automobile construction cast metal has yielded place to forged, thereby securing greater reliability, reducing weight, and usually obtaining a cleaner appearance. The same tendency is now at work in wheel construction.

In pleasure-cars there has been no serious attempt to supersede the wooden wheel by a cast metal wheel, but the development has proceeded directly from the wooden wheel to the forged wheel, the

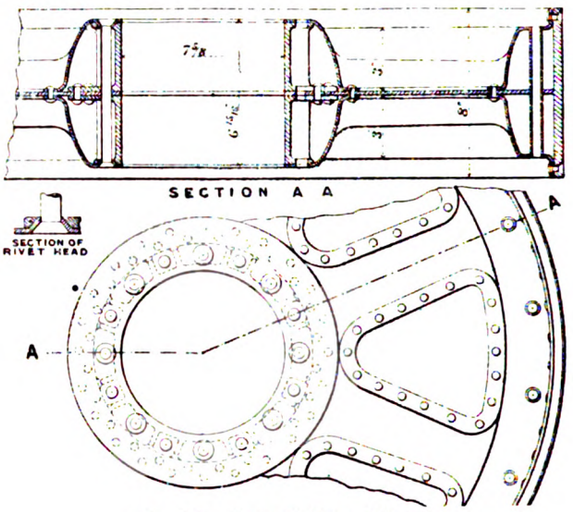


Fig. 18.—Forged Rear Wheel.
(Same Scale as Fig. 17.)

latter being formed of two pressed-steel sections welded together by the oxy-acetylene blow-pipe (Fig. 19). This type of forged wheel, although coming rapidly into favour for pleasure cars, has not proved equally satisfactory for heavier duty. When reinforced by a steel disc in the centre plane of the wheel, as shown in Fig. 18, this wheel has proved serviceable on 3-ton vehicles, but a lighter

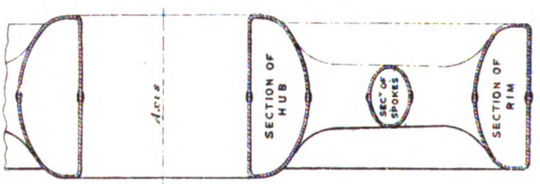


Fig. 19.—Pressed Steel Wheel.

type of forged wheel has now been produced and is shown in Fig. 20. This wheel is of the built-up type. The rim is pressed or rolled to a channel or **Z** section. The hub is a drop forging, having bosses corresponding with the spokes, which are of seamless steel tube; and the hub-bosses are machined to a section corresponding with the tubular spokes. The spokes and the hub are "butt-welded" by electrical resistance. The outer ends of spokes are united in a similar manner to flanges, which are curved to fit the rim. After testing the welds, the spoke-flanges are turned to suit the rim. A small degree of shrinkage is allowed on the rim to secure a close fit. After shrinking on the rim it is secured to the spoke-flanges either by riveting or by spot welding. The outside of the rim is then turned to fit the rubber tire. This form of wheel is more expensive than a cast wheel, but it gives the maximum strength with the minimum weight of metal. The wheel is true and perfectly balanced, owing to the uniform section and quality of the material, and in consequence the wear of the tires is reduced. In this wheel it is practicable to use special high-tensile steels, heat-treated. Internal stresses (which are due to variable contraction or the imperfect annealing of castings) are of course absent, and the whole strength of the material is available for duty, without any deduction or loss from internal strains.

The benefit of reduced wheel-weight to the users of commercial motors may be illustrated by a simple calculation showing the effect of 100 lb. reduction in the weight of each motor omnibus in London.

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Each omnibus runs more than 30,000 miles per annum. Taking the number of omnibuses at 4,000, 100 lb. per omnibus represents each year a saving of more than 5,000,000 ton-miles. Taking the cost of traction at ½d. per ton-mile, this saving exceeds £10,000 per annum. The number of omnibuses in London is not one-tenth of the number of other commercial motors in this country.

In connection with the saving in the cost of road-maintenance, it is important to remember that each 100 lb. saved in the weight of unsprung parts, such as wheels, is of greater benefit to the tires and road-surface than a similar saving of weight in any other part of the vehicle.

The action of the Commissioner of Metropolitan Police in decreeing that the weight of motor omnibuses shall not exceed 3½ tons unladen, or 6 tons gross load (which is about 1 ton lighter than the weights obtaining previously), has had a very beneficial influence upon the construction of these vehicles. At first there was a disposition to regard the decision of the Commissioner as an obstacle to the development of the motor omnibus, and to believe that such a limitation of weight would prevent a proper margin of strength from being provided in an omnibus of standard carrying capacity. It is now universally admitted, however, that the decision of the Commissioner—although setting the engineer a difficult task—has conferred substantial benefit on the motor omnibus companies. The lighter type of vehicle costs less for fuel, tires, and general maintenance, and in addition, the public expense for road-maintenance has likewise been reduced.

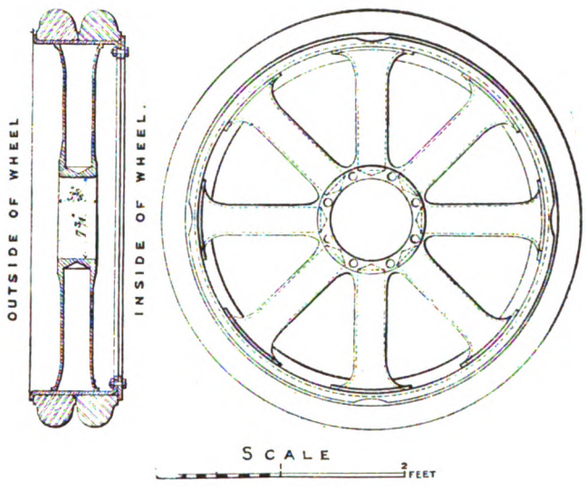

Fig. 20.—Rear Tire.

Electric Commercial Vehicles

As already mentioned, the electric commercial vehicle has been developed in the United States during the last 10 years to an extent which is truly surprising, having regard to the fact that practically nothing has been done in Europe to develop the use of this type of motor.

During a visit to the United States in the summer of 1913, the author inspected some of the factories where vehicles of this type are constructed, and formed the opinion that extensive employment of the commercial electric vehicle in Europe is inevitable.

With respect to durability, electric trucks built 12 years ago are still in daily service, and many seen in the streets are 6 to 11 years old. Assuming that reasonable care is taken of the vehicle, a life of 10 years is easily obtainable.

The storage-batteries are of two types, the lead and the Edison.

The ordinary lead battery is considered to have a life of about 10,000 miles during a period of 1 year. As is natural in such apparatus, some users get less and others more than this, according to the way in which the batteries are used and looked after. The Edison battery is constructed of steel; it has an alkaline electrolyte, and is guaranteed by the maker for 4 years.

With either make of battery, and with current in the neighbourhood of ¾d. per unit and petrol at 1s. 4d. per gallon, the electric vehicle seems to have the advantage, and there appears to be no room for doubt that it will take an important share in town delivery-work.

Experience in New York indicates that in congested traffic the ordinary delivery van can travel only about 35 miles per day at an average speed of approximately 9 to 12 miles per hour, and as the traffic in London is probably more congested than in any other city in the world, the outlook for the electric commercial vehicle here seems distinctly promising.

In America the vehicles are usually bought and maintained by the user. In certain special cases a 3-year maintenance agreement is made with the user, covering the supply of parts required for mechanical repairs and replacements, renewal of tires, and battery-renewals, on the basis that the purchaser will buy such material exclusively from the manufacturer for a period of 3 years, and that if or when his bills amount to a certain figure, additional material for the 3-year period will be supplied free of charge. The contract covers material, but not the labour of applying it. The agreement is based on monthly reports of the mileage run, and the maximum limit of the amount of the bills is increased by a specified amount per mile for each mile in excess of the amount specified.

This is not the usual procedure, and only a few contracts of the kind appear to be in force, as the users have found, after buying a few cars, that they do not need such protection.

The guarantee given with a new vehicle, sold direct to the customer, is that the manufacturer undertakes to replace defective material within 90 days. Tires have the usual 10,000 miles guarantee, to be run within 18 months.

With regard to running expenses, the author cannot do better than refer to the systematic observations and records which have been collected and scheduled by the Massachusetts Institute of Technology during the last few years. The Research Department of that institution has gone into this matter very thoroughly, and has acted as a clearing-house for the actual costs obtained by users of both electric and internal-combustion motors and horse traction, under the ordinary conditions of everyday employment.

The data collected up to March 1, 1912, were summarised in a bulletin entitled the "Economical Transportation of Merchandise in Metropolitan Districts."

Since that time reports of operation from a number of other users have been obtained.

The cost data of motor trucks collected before October 1, 1912, were summarised in a paper entitled "Notes on the Cost of Motor Trucking," which was presented at the 1912 Convention of the Electric Vehicle Association of America. In this paper, which was subsequently issued as "Vehicle Research Bulletin No. 2," some of the more important factors bearing upon the use and the cost of working of motor trucks were discussed.

The report of the Massachusetts Institute calls attention to the importance of the human element and to the drivers' mental attitude as a decisive factor in working costs. It is laid down that the horse should not be driven too fast nor too far; nor should the motor truck be overloaded, over-speeded, or run without proper inspection. In some services it is understood tacitly among the drivers that a certain number of trips or deliveries constitute a day's work. If this quantity of work can be done by a horse-wagon, a motor truck is a most precluded. But in general the substitution of motors for horses may be expected to speed up all the movements of the driver. This acceleration tends to decrease the standing time for loading and unloading. Such a tendency has already been observed.

Present Trucking Conditions.

For an understanding of the methods involved in these investigations an insight is necessary into the conditions influencing wagon-operation. The service to be performed in the moving of merchandise within a thickly populated area, such as a large city and the surrounding suburbs, may range from the delivery of a small parcel to a customer's house, up to the transport of heavy goods from a railway terminus to a warehouse. The three types of vehicles which were tested for such work are: (1) the horse-drawn truck; (2) the gasoline truck; and (3) the electric truck.

The type of vehicle best suited for a particular service is in general dependent upon the nature of that service. A complete understanding of the character of the service to be performed, as well as a thorough knowledge of how each element of the service affects the cost of working of each type of vehicle, is essential before a decision can be reached as to the relative economy of the three types of vehicles.

Importance of Standing-Time.—The amount of work which any truck can do in a working-day depends, first, upon the number of miles it is driven in a day, and secondly, upon the standing-time or time taken in loading and unloading. The first item depends primarily upon the speed of the truck, although in congested districts the speed

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may be largely determined by the average speed of all the traffic using the street. But the second item, which is equally important, depends primarily upon the loading and unloading conditions. The importance of the effect of standing time upon the cost of operation is frequently overlooked; yet this time item must be carefully considered, particularly when motors are used.

Short Hauls.—As an illustration, consider a horse-drawn wagon which travels 15 miles per day, but which is actually moving only 3 out of 9 working hours, the average speed of the wagon being, therefore, 5 miles per hour. If this wagon were replaced by an electric truck of the same carrying capacity, whose average speed under the same traffic conditions would be 10 miles per hour, the motor truck would cover the 15 miles in $15/10 = 1{\cdot}5$ hour; but if the loading and unloading conditions remained the same the time required to perform the same service would be $6 + 1{\cdot}5 = 7{\cdot}5$ hours. That is, in 9 hours the motor truck could do only $9/7{\cdot}5 = 1{\cdot}20$, or 20 per cent. more work, although its speed is twice that of the horse wagon.

However, in many short-haul services the superior ability of the motor truck, in comparison with the horse-drawn wagon, to get into position where considerable backing and other manœuvring is necessary, may be of equal importance with the higher speed of the motor. This point is frequently noticed in work about mill yards, where the hauls may be comparatively short, but where facility in reaching inconveniently situated platforms may be exceedingly important. The influence of the driver's mental attitude may also

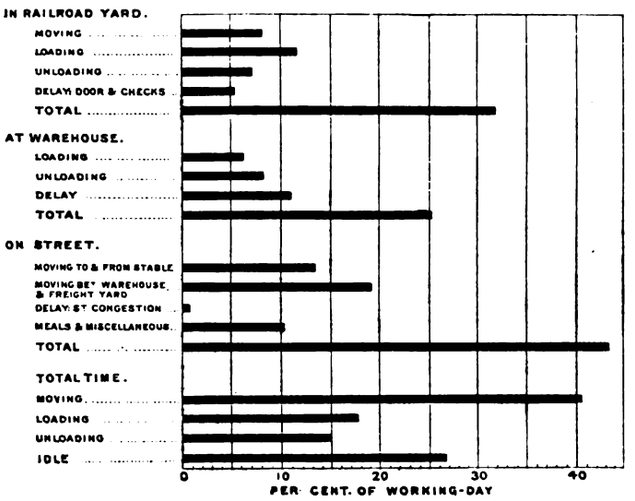

Fig. 21.—Horse Wagon's Day of Service.

shorten the standing time of the motor, and thus increase its quantity of work per day.

Long Hauls.—Work of long-haul character affords to the motor an opportunity to utilise its superiority over horses in the matter of higher speed and mileage capacity. In the case of a city store delivering goods to suburban branches, the length of a single trip is frequently as much as 15 miles, which would constitute a full day's work for horses. A motor can readily make two or even three trips in a day, as the standing time in such service can be made very small by proper loading and unloading facilities. Here the motor is able to multiply the tonnage dealt with in a day, and also to increase the number of deliveries between store and branch.

Mileage Factor.—The ratio of the actual number of miles per day which a vehicle is driven to the number of miles per day it is capable of running, under average conditions and without interference from other traffic, may be called the "mileage factor" of the vehicle in that particular service. The greater the mileage factor in any service the less will be the cost per unit of the service. Every effort should therefore be made to maintain a high mileage factor. To accomplish this when motors are substituted for horse wagons may require considerable change in methods.

Load Factor.—In addition to a good mileage factor, the load factor or the ratio of the maximum load per trip to the rated capacity of the wagon, should also be kept as high as possible. In some services, where the quantity of work varies considerably with the season of the year, this may be a difficult adjustment, but in any case the size of vehicle should be carefully chosen to suit its use.

Delivery of Goods.—The haulage of goods from railway goods shed to dealer's warehouse, or vice versa, presents a particularly complicated problem, owing to the diverse conditions which must be met, such as the organisation of the railway goods sheds, the relative situations of the stables and wholesale areas of the city, the fact that teams and merchandise are frequently owned by different parties, etc.

In addition to the time often lost by a wagon at warehouse or goods yard in receiving its load, the usual practice whereby a wagon is moving with a full load for a comparatively small portion of the working day is also uneconomical.

The Massachusetts Institute of Technology has made a number of studies upon the manner in which horse-wagons spend the day in the service of hauling goods. Information was collected by recording every movement of a selected wagon, from its departure from the stable in the morning until its return at night The result of one of these studies, covering thirteen wagon-days' performance, is shown graphically in Fig. 21, in which the length of the horizontal lines represents the portion of the total working-day, or time out of stable (average 10·7 hours), spent as indicated.

The average number of loads hauled between warehouse and goods-yard was 3·5 per day, and the average weight per load was 1·8 ton. The total distance travelled per day was 13·5 miles, and the average length of haul was 0·9 mile.

It is evident that a vast amount of "lost motion" occurs with the present method of carrying out this work. The wagons are moving with a load, i.e., are performing their intended function, for only a small portion of the day, and the average load is less than half that which the wagons could carry over the necessarily short distances, provided the goods were collected and the business so organised that larger loads could be obtained.

Cost Data.—Although mechanically-driven wagons possess evident advantages in rapidity and radius of movement as compared with horse-driven vehicles, the determining factor in selecting a vehicle for a given service is usually the cost of performing that service. An additional cost of a fraction of a penny per package may be more than offset by the increase in business due to a reputation for reliability and punctuality in delivery.

Performance Data.

The second, and equally important, portion of the study has been analysis of the performance of vehicles in different services. The information at present available on this subject is extremely meagre, particularly in the case of horse-drawn wagons. The relative costs of performing a given service by means of the three types of vehicles, however, depend to a marked degree upon the nature of the service, particularly upon the loading and unloading conditions, and the limitations of speed due to street traffic. In order to obtain accurate data upon this subject, the Massachusetts Institute of Technology had installed, on a number of wagons and trucks, special recorders, which furnished tapes indicating the stops and movements of each vehicle.

This investigation included the movements of 63 vehicles, ranging in size from one-horse to three-horse wagons, and 700-lb. to 10,000-lb. motor trucks. It covered the work of each vehicle throughout two to eight months during the winter, spring, and summer of 1912. From each tape a number of observations were made with reference to moving time, standing time, speed, distance, etc.

Some typical averages of these observations are given in the table on the following page, which is taken from the Institute's Report.

In considering these results, it will be noted that for the light cars, such as the 1,000-lb. rating, the superiority of the automobile over horse wagons in so-called suburban service is extremely marked. This is work in which there are hauls of considerable length between the points of loading and beginning distribution. It will also be noted that, in a limited area, *e.g.*, within a four-mile radius of a loading point, the superiority of motor cars over horse wagons increases to a marked extent with the size of the load.

The foregoing conclusions are not applicable to all classes of work of the types considered, but only to cases in which the conditions are similar to those upon which the estimates are based. The specific services selected are particularly suited for electric trucks. Other services, in which the distances travelled per day exceed 45 miles, would in many cases show a decided advantage in favour of the gasoline vehicle; and for very small daily distances, say, 12 miles or less, the horse wagon would probably prove the cheaper. It must be borne in mind, however, that each change in service requirements will produce a corresponding change in the cost of performing the service. In other words, service requirements are as important a factor in determining costs as is the type of vehicle selected.

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AVERAGE PERFORMANCE OF SIX WAGONS.

Rating	1,000 lb.	4,000 lb.	3,000 lb.	6,000 lb	1-Horse	2-Horse
Type	Electric	Electric	Gasoline	Gasoline	Wagon	Caravan
Company number	51	9	5	30	35	29
Company's number for truck	2	93	158	1	325	941
Service	A	B	C	D	E	F
Months of record ..	8	8	7	7	5	6
Miles per day ..	35·1	19·9	42·7	24·7	11·7	12·2
Trips per day ..	1·8	4·1	4·0	2·0	2·4	3·8
Stops per day ..	27	12	38	12	13	14
Miles per trip ..	19·5	4·9	10·7	12·4	4·9	3·2
Office to first stop, miles ..	2·4	1·9	3·2	3·1	1·1	1·3
Office to last stop, miles ..	2·7	1·5	2·8	4·1	1·6	1·7
Hours in use per day ..	10·3	9·2	10·8	9·7	9·7	10·1
Hours standing per day ..	6·4	6·4	7·3	6·8	5·7	6·1
Hours moving per day ..	3·9	2·8	3·5	2·9	4·0	4·0
Hour loading per trip ..	0·5	..	..	..	..	0·6
Hour unloading per trip ..	..	..	..	..	..	0·6
Hour for meals ..	..	..	1·0	..	1·3	1·1
Calls per day ..	..	11·0	..	..	6·0	7·2
Pieces delivered per day ..	..	..	40	..	..	..
Pounds initial load per day	..	8,600	..	..	7,300	29,400
Average running-speed, long runs	10·6	7·9	14·8	8·8	..	..
Average running-speed throughout day ..	9·8	7·0	12·3	8·5	3·0	3·0
Days used per month ..	21·8	27·2	17·5	20·7	21·8	24·0
Days out of commission per month ..	2·4	0·2	4·8	4·6	3·1	0·0
Days ready but not used per month ..	6·4	3·0	8·2	5·1	5·5	6·3

The letters indicating the service have the following significance:—

A—Suburban parcel delivery;
B—Miscellaneous hauling;
C—Suburban baggage call and delivery;
D—Furniture moving and miscellaneous trucking;
E—Retail coal delivery;
F—Outbound freight for manufacturer.

STEAM MOTOR WAGONS AND TRACTORS TO COMPLY WITH THE HEAVY MOTOR CAR ORDERS.

The Motor Car Acts of 1896 and 1903 have undoubtedly revolutionised the carrying trade of this country, for to-day thousands of steam wagons, steam tractors, and petrol lorries complying with these Acts are doing the work previously carried out by the railways and by horse teams.

The steam motor tractor and steam lorry were introduced on a commercial scale within a very short time after these Acts came into force.

Previously one or two leading firms of road locomotive and traction engine manufacturers had experimented with light engines for dealing with light loads, but the restrictions of the Road Locomotives Acts as to speed, licences, etc., prevented anything like a constant demand.

The advent of the Heavy Motor Car Orders allowed makers to devote their energies to the perfection of an engine, the two principal points being that the unladen weight should not exceed 5 tons, and the speed 5 miles per hour, for engines with steel tires, and 12 miles per hour for engines with solid rubber tires. Under these rules, two types of engines were brought out, namely, the self-contained motor wagon or lorry and the motor tractor. The former, of course, carried the engine and load in one frame, while the tractor hauled the load on a separate trailer.

As the Acts state that only one trailer can be hauled at a time, the motor wagon with a load in its body and a trailer behind gave a greater floor-space and carrying-capacity than the tractor with only its trailer to load.

Each of these types of engine has its advantages; for instance, where bulky goods have to be hauled, such as furniture, paper, etc., and where the engine is continually running on hard main roads, the motor wagon will give better results than the tractor. Where the goods have to be hauled over rough and unmade roads, the tractor with a trailer has the advantage, as the load being separate from the engine, the weight on four wheels is not so great, and in the case of any difficulty the tractor can be detached from its load and run ahead, and can then pull the loaded trailer out of its difficulty by means of a drum and steel wire rope, which is fitted to the axle of these engines.

With regard to construction, few improvements have been made since these engines were first introduced, as they followed very closely the lines of the heavy road locomotives and traction engines, which have been constructed and improved from time to time during the past 50 years.

The type of steam wagon which has proved most suitable is fitted with a horizontal boiler and firebox, of what may be called the road locomotive type.

Of course, the tractor followed this line in practically every respect; but among the improvements recently introduced by leading firms, the following may be mentioned:—The gearing is now machine-cut, ensuring the minimum of friction and wear and tear. The pump has been altered from a direct-acting pump off the crank shaft to a gear-driven pump, with the result of giving a lower speed to the pump and ensuring its perfect working even when the engine is running at full speed.

The boiler and firebox of the tractor is constructed on the Belpaire principle with a square top over the firebox; this considerably increases the steam-capacity of the boiler—a point of much importance with these small engines—and at the same time better staying is secured than with the round boilers previously fitted.

The daily cost of running either a steam tractor or a steam wagon would be approximately:—

	s.	d.
Driver	5	0
Assistant (if required, but not necessary under the Act)	3	0
Fuel (coal)	4	0
Oil and waste	0	10
Interest on capital 5 per cent., depreciation 7½ per cent., repairs 7½ per cent.	6	8
Insurance and sundries	2	0
Total	21	6

The ordinary day's run with a standard engine would be about 35 to 40 miles, and the load taken with a steam wagon would be 5 to 6 tons in the body, and 2 to 3 tons in the trailer, while with a tractor the load taken would be about 6 tons, in the trailer.

It is not the practice to fit rubber tires to the tractor wheels, but many steam wagons are fitted with rubber tires, increasing the speed in the case of a 5-ton engine to 8 miles per hour, and in the case of the 3-ton engine to 12 miles per hour. While the fitting of these rubber tires increases the mileage, the cost of tires (about 2½d. per mile) must be added to the above estimate.

The author desires to thank Mr. Walter J. Iden, Chief Engineer of the London General Omnibus Company, for kindly furnishing drawings of the latest type of "General" motor omnibus.

STRAKER-SQUIRE COMPONENT PARTS.

One of the most complete and useful catalogues of component parts of motor chassis which we have seen has just been published by Messrs. Straker-Squire, of Nelson Square, Blackfriars, London, S.E. The booklet embodies complete illustrated particulars of all parts of the type of chassis mentioned, and it is therefore only necessary for those requiring parts to order according to the instructions set out in the book to ensure the prompt receipt of any replacement down to the most minute detail. Each section of the chassis is separately dealt with, both collectively and individually. In the case of the engine two views are given, the front sectional view and the side sectional view, all the parts being clearly indicated and numbered, while the description of each with the reference number and the order number are given on opposite pages. This is followed by numbered illustrations of each part of the engine, again with the reference number, order number, and description on facing pages. The carburetter is dealt with separately, as is each of the component parts that go to make up the complete chassis. The drawings and photographs from which the illustrations have been prepared are excellent examples of the kind, and the whole work reflects much credit upon the compiler of the catalogue. We understand that a copy of the catalogue will be sent post free to any user of "Straker-Squire" machines.

REPLACEMENT OF TILLING-STEVENS OMNIBUSES.—The Trent Motor Traction Company has obtained a new fleet of Tilling-Stevens petrol-electric omnibuses to replace the vehicles that were impressed by the military authorities. The new vehicles are each fitted with handsome saloon-type bodies.

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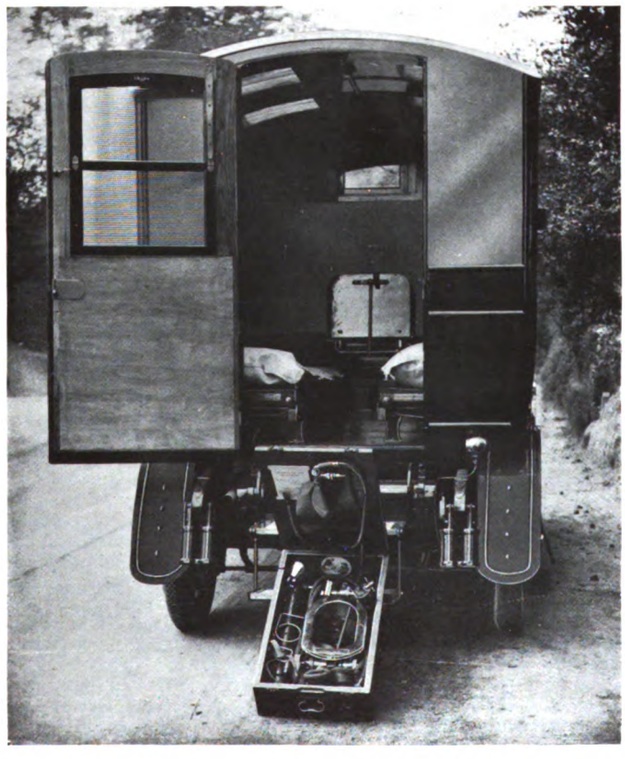
DENNIS AMBULANCE WITH SPECIAL EQUIPMENT.

An ambulance fitted up with an equipment of more than usual interest has recently been delivered by Messrs. Dennis Bros., of Guildford, to the Wimbledon Fire Brigade. The general appearance of the vehicle is shown in the accompanying photograph, in which it is seen standing in front of the ruins of an old Abbey. The photograph below shows an interior view of the vehicle itself, and also illustrates some of the most interesting of its special features and fittings.

It will be observed that the springing of the car has received particular attention. The body was specially constructed to the design of the Wimbledon Corporation. It is lighted by windows in the roof as well as by a small light at the forward end, and a large window in the rear door.

The car is designed to carry two stretchers and two seats for attendants, and is also provided with a small wash basin, the water for which is supplied from a tank, and a box containing Carter's Red Cross first-aid outfit. At night time the machine is lighted by a dynamo lighting outfit. It has been constructed for street accident work, and also for private transportation, and has been specially fitted up with air beds made of rubber, shaped at one end like a pillow, and inflated by means of a small pair of bellows.

Perhaps its most interesting fitting is the Pulmotor apparatus, which is shown resting upon the rear steps. This is a modern improvement on the old methods of artificial respiration. The Pulmotor supplies oxygen to the lungs of the patient from a substantial oxygen cylinder through a pressure reducing valve. The appliance is a very extraordinary one, inasmuch as when put into action it continues to imitate exactly the processes of respiration, adjusting itself to the natural rhythm suitable for the lungs of the patient under treatment. Without going into complete details, it may be said that this is effected by means of a device in the nature of an injector working in conjunction with small leather bellows of accordion shape. The movements of these bellows are caused to



Interior of Ambulance with Pulmotor Apparatus.

bring about corresponding movements in valves, with the result that oxygen is drawn into the lungs until they are filled to the normal pressure, after which the valves automatically adjust themselves, the injector empties the lungs by suction, and the operation is again repeated. The speed of the rhythm is of course dependent entirely on the capacity of the lungs.

With such a system, the whole attention of the skilled attendant can be given to important details, such as keeping the windpipe open and the gullet closed. Moreover, in cases where the patient may have sustained internal injuries or fractures, an automatic method of this kind is obviously much superior to a mechanical movement of the arms which may cause great pain or injury.

Dennis Ambulance for Wimbledon Fire Brigade.

PARIS OMNIBUS SERVICES.

In a previous issue reference was made to the efforts the Paris omnibus undertaking was making to re-establish some of its services. It is now understood that definite arrangements have been made with the military authorities whereby the company will be permitted to run 100 of its new single-deck vehicles in order to maintain six of its most important services. On the outbreak of war the whole of the company's fleet was requisitioned for military service, and although orders were immediately placed for new machines, until now the company has been unable to get any sort of undertaking from the French Government that these would not also be taken. As a result not a single motor omnibus has been run in Paris since August last. There will be a reduction in the weight of the new vehicles, and electric lighting will be introduced. Some objection having been raised by Parisians to the abolition of the double-deck vehicle, the company has replied that conductors experience a difficulty in collecting the fares on the top deck; that the double-deck vehicle in bad weather has its carrying capacity reduced by half, for Parisians will not sit outside when it rains or is cold; and that it diminishes the "commercial speed" of the omnibus, as it has to be brought to a dead stop while the passengers on the top get off.

Motor Vehicle Exhibits at the Royal Agricultural Show.—The seventy-sixth annual show of the Royal Agricultural Society of England will be held at Nottingham this year, and will be open to the public from June 29th to July 3rd. Although it is not to be expected that the exhibits in the implement section, which includes motor vehicles, will be as comprehensive as is usual at the Royal Shows, many well-known manufacturers have secured space, and the steam section of mechanical transport will be well represented.

Foreign Motor Dictionaries for the Front.—The Commercial Motor Users' Association has, at the request of the Director of Transport of the British Expeditionary Force, presented a further supply of several thousand copies of the "Sternol" Pocket Motor Dictionary for the use of the motor transport drivers on active service. The dictionary, which is printed in English, French, and German, is of a size suitable for the waistcoat pocket, and comprises 12 pages, containing 500 references to the construction and running of a motor vehicle. The communications that the Association has already received indicate that the booklets are proving a great boon to the drivers and a valuable asset in the field.

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Daimler Company's regular weekly delivery of 25 C.B. type of 2-ton lorries for the War Office.
This number has been maintained each week, without a break, since the beginning of the year.

NATIONAL ROAD CONFERENCE AND EXHIBITION.

In conjunction with an exhibition of road material, etc., which will be held during the present month and also in July at the Royal Horticultural Hall, the County Councils Association of England and Wales have decided to hold a road conference, at which will be discussed a number of important points in connection with road questions, prominent amongst them being several having reference to motor traffic. The exhibition of materials will be held in the Royal Horticultural Hall, Westminster, and the machinery section will be on a site adjacent to the hall which has been secured for the purpose.

The Organising Committee, which will be as representative as possible of all the bodies and societies concerned with the control and use of roads, has the Right Hon. H. Hobhouse (chairman of Somerset C.C.) as its chairman. The organising secretary is Mr. G. Montagu Harris (secretary of the County Councils Association). Mr. F. Hyndman is assistant secretary, and the business manager is Mr. A. F. May, 13, Victoria Street, Westminster, S.W.

Conferences and meetings on road matters will be held every day during which the exhibition is open, most of them on the premises of the exhibition itself. The preliminary arrangements are as follow :—

June 25 and 26.—Annual meeting of the Institution of Municipal and County Engineers, when the following subjects will be discussed :—

(1) The improvement and maintenance of highways in connection with modern traffic conditions.

(2) The use of reinforced concrete in buildings, road construction, etc.

(3) Town planning.

(4) Haulage by mechanical means *v.* horse power from an economical point of view.

(5) Restriction and control of heavy traffic, both as regards weight and speed.

(6) The maintenance and strengthening of iron and steel bridges.

June 28.—Conference on " The adequacy of bituminous roads, with special reference to the subject of corrugations," and other matters.

June 29.—Conference on heavy traffic.

June 30.—Morning : Meeting of Executive Council of County Councils Association. Afternoon : Conference on the Classification of Roads.

July 1.—Conference on the Reconstruction of Roads in Belgium, arranged jointly by the County Council Association and a special committee which has been formed in connection with the rebuilding of Belgium.

Invitations have been addressed to all the local authorities in Great Britain and Ireland, to Members of Parliament, to Belgian and other foreign engineers in this country, and to all societies and institutions interested in the control and care of roads.

THE ELECTRIC VEHICLE COMMITTEE.

A meeting of this committee was held in London under the chairmanship of Mr. R. A. Chattock, on May 11. Mr. A. E. Collins, city engineer of Norwich, took his seat upon the committee as the representative of the Institution of Municipal and County Engineers, while Mr. A. de Turckheim was present as the representative, *pro tem.*, of the Tramways and Light Railways Association, and Mr. G. F. Heath as the representative of garage interests.

The Hon. Secretary (Mr. F. Ayton) read the draft of the report to be submitted for discussion at the annual meeting of the I.M.E.A on June 17, entitled " The Uses of the Electric Vehicle in Municipal Service." The arrangements were discussed for the proposed parade of electric vehicles on June 17, and the time was provisionally fixed for 5 p.m.

In the matter of further standardising of details appertaining to lead plate batteries, the committee has decided to ask the accumulator section of the " Beama " to consider the desirability of bringing about the standardisation in regard to :—(*a*) The clearance for the accumulation of sludge between the lower edge of the plates and the bottom of the cell container ; (*b*) the size of the filler plug hole and a design of plug for same ; (*c*) the distance between the top of the lip of the plug hole and the top edges of the plates, so that one gauge may always be used in a garage for fixing the proper level of the electrolyte, measuring from the top edge of the filler hole lip ; (*d*) details of connectors between cells and method of connecting these to the plate terminals.

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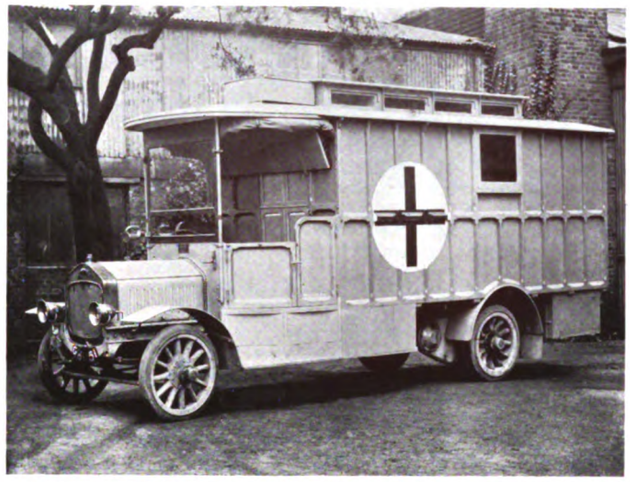
MOTOR TRAFFIC.

ALBION MOTOR LABORATORY.

AN ACQUISITION TO THE WELSH ARMY CORPS.

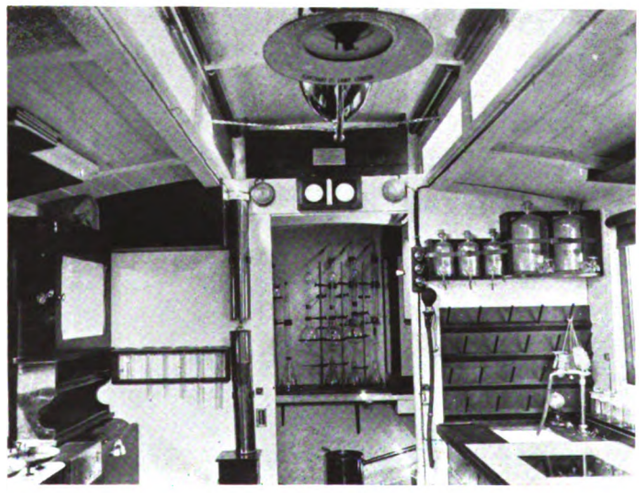
The three photographs reproduced on this page give a general idea of the bacteriological laboratory car which has been supplied to the Welsh Army Corps, now completing its training in the district of Colwyn Bay.

The chassis is a 25 H.P. Albion, and the complete machine has been inspected by Mr. Lloyd George, who expressed his gratification that so complete an equipment has been provided. Great ingenuity has



Albion 25 h.p. Bacteriological Laboratory.

been shown in the construction of the body. Evidence of this fact is shown by the photograph giving an external view of the car. Above the driver's seat there is a folding berth for the orderly, while the driver can also arrange his seat as a sleeping berth. In addition to windows at the sides, there are lights in the roof, where a water tank is also fitted.



View of Rear and Forward Compartments.

There are two compartments to the vehicle, a door giving communication between them. There is such a marked absence of vibration that the risk usually attaching to the carriage of so many glass instruments has been overcome. The annexed photograph shows the manner in which the tubes, etc., have been arranged in the front compartment. The rear compartment contains the remainder of the equipment, and also sleeping accommodation for the medical man and his assistant.

MOTOR VEHICLES FOR MUNICIPALITIES.

DEPTFORD BOROUGH COUNCIL has decided to purchase two motor sweepers.

EDINBURGH CORPORATION has recently taken delivery of two motor fire engines.

KENSINGTON BOROUGH COUNCIL has under consideration the purchase of a motor sweeper.

BIRMINGHAM WATCH COMMITTEE recommend the Corporation to purchase a motor ambulance.

WATFORD URBAN DISTRICT COUNCIL has under consideration the purchase of a motor fire engine.

SOUTHPORT CORPORATION has decided to purchase a motor lorry for use in the highways department.

DURHAM COUNTY COUNCIL has decided to purchase three steam tractors for use in the highways department.

ROCHDALE CLEANSING COMMITTEE is considering a proposal for the purchase of a motor sweeping machine.

DERBY CORPORATION has accepted the tender of Messrs. Foden, Limited, for the supply of a 5-ton steam wagon.

ILFORD URBAN DISTRICT COUNCIL has placed an order for an Edison electric wagon fitted with automatic tipping gear.

ROCHESTER CORPORATION has placed an order with Merryweather, Limited, for the supply of a motor fire engine of the Hatfield type.

NEWPORT CORPORATION has under consideration the purchase of two motor ambulances, recommended by the Health Committee.

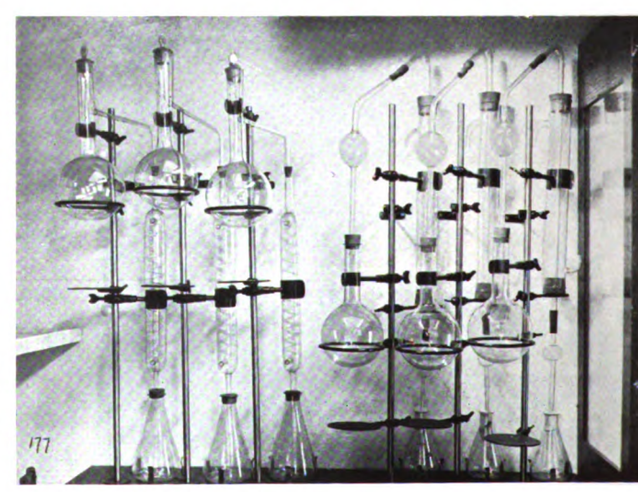
STOURBRIDGE FIRE BRIGADE is to be provided with a motor fire engine. The £1,200 required is being raised by public subscription.

MELBOURNE METROPOLITAN FIRE BRIGADE BOARD has under consideration a scheme for the complete equipment of its brigade with motor fire-fighting appliances.

BISHOP'S STRETFORD URBAN COUNCIL has under consideration a proposal from the Fire Brigade Committee for the purchase of a motor vehicle for the purpose of hauling its steam fire engine.

HULL CORPORATION has placed an order with Messrs. Alley and McLellen for a 6-ton Sentinal steam wagon. A proposal to purchase two ambulances was, on June 3, referred back to the Health Committee.

LONDON COUNTY COUNCIL has placed an order with Tilling-Stevens, Limited, of Maidstone, for a petrol-electric lorry for use with the fire brigade. The Council has decided to equip the Bayswater fire station with motor appliances.



Forward Compartment, Welsh Army Corps Laboratory.

TIMARU BOROUGH COUNCIL (New Zealand) invite tenders for the supply and delivery of a motor street water sprinkler. Particulars can be obtained from the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

CROWBOROUGH AND DISTRICT FIRE BRIGADE is desirous of obtaining a motor fire engine. Mr. H. E. Sheppard, J.P., the honorary chief officer, is endeavouring to raise a sum of £600 to cover the cost, towards which he has himself subscribed generously.

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MOTOR TRAFFIC.

BARRY PORT URBAN COUNCIL has granted permission to Llanelly and District Transport Company to run a motor omnibus service from Llanelly to Barry Port and Pembrey. We understand that the service will be commenced as soon as possible, and that six 40-H.P. vehicles will be employed.

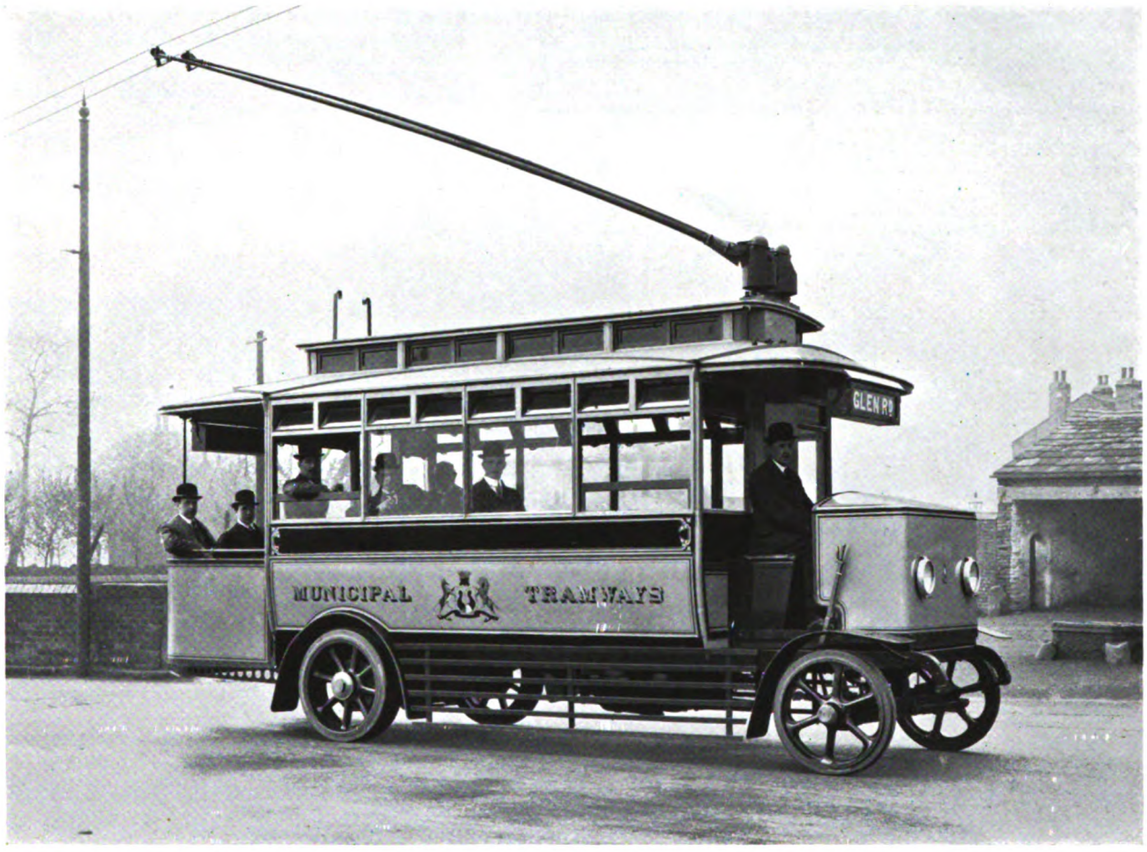
SHEFFIELD CORPORATION has under consideration a proposal to dispense entirely with horse traction in connection with street refuse collection. A sub-committee has now recommended that further purchases of horses be made, probably on account of the unwillingness of the Government to sanction loans for large outlays.

SOUTHPORT CORPORATION has recently taken delivery of a new type of convertible watering van and tipping wagon, supplied by Thos. Green and Sons, Limited, of Leeds. The water tank is fitted with two sprinklers at the front, the width of the spread being under the control of the driver. The distributing apparatus includes a rotary pump driven from the engine shaft, which delivers the water to the sprinklers under pressure sufficient to cover a 60-ft. road if necessary. The tank is removed by means of two lifting eyes and the steel wagon tipping body can then be placed in position.

EDISON ACCUMULATORS, LIMITED, are to supply six electrically-driven tip wagons for the collection of house refuse to Dover Corporation. These vehicles will be equipped with Edison accumulators, and will have a capacity of two tons. Mr. W. H. L. Watson, of Edison Accumulators, Limited, attended a Council meeting recently, and explained the working of the Edison machines. The vehicles will be charged at the Corporation electricity works—three every night. The estimated running cost is £178 per annum per vehicle, this figure covering maintenance of tires. Each wagon will take the place of sixteen horses and three carts, and will run about twenty miles a day. The batteries have sufficient power to drive a car about 45 miles on a single charge, and are guaranteed to maintain their rated capacity after running 60,000 miles. The vehicles will climb a gradient of one in three. It is anticipated that there will be a considerable saving as compared with the present method of collecting the refuse.

EDISON ACCUMULATORS, LIMITED, have also an order from Ilford Urban District Council for an electric wagon of four tons capacity, with Edison batteries and automatic tipping gear, at £1,240. The electrical engineer reports that the tenders received included three types of battery—namely, lead (ironclad), and Edison. The lowest cost, guaranteeing 12,000 tons of coal only, was quoted by Cedes Electric Traction, Limited. The next lowest was that of Edison Accumulators, which was only £6 above that of the Cedes Company. The engineer expressed the opinion that the best proposal was that of the Edison Accumulators, Limited, for although the first cost was rather higher the running cost was less, and at the end of ten years, when the capital expenditure has been wiped out, the vehicle would still be fit for several years' service.

BARNES URBAN DISTRICT COUNCIL desired to purchase electrically-propelled dust vans from Edison Accumulators, Limited, and the latter have agreed to accept payment in four annual amounts of £1,060 each for the vans. The Local Government Board have, however, refused to sanction the loan, and the Council have therefore declined the offer.



R.E.T. Cars for Bloemfontein Municipal Tramways.

RAILLESS CARS FOR BLOEMFONTEIN.

The cars that are being supplied to Bloemfontein Corporation by the R.E.T. Construction Company, Limited, are now undergoing trial runs, and will be shipped in a short time. There are ten cars in all. The accompanying illustration shows the general design, and in a later issue we shall give further details of their construction.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The last meeting this session of the Institution of Automobile Engineers was held on May 12, in the Hall of the Institution of Civil Engineers, Great George Street, Westminster, S.W., when Mr. Arthur Stubbs read a paper entitled "Drop Forgings and the Automobile Industry." The author will deal at some length with the advantages of drop forgings for use in motor car parts, the parts which are suitable for drop forging, the materials which should be used, and the relations between the automobile engineer, the drop forger, and the steel maker.

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MOTOR TRAFFIC.

WITH THE EXPEDITIONARY FORCE.

PERFORMANCES OF HALLEY LORRIES AND A COMMER CAR.

Appended is an extract from a letter received by one of the staff of Halley's Industrial Motors, Limited, from Staff-Sergeant A. M. Watson, A.S.C., M.T., of the British Expeditionary Force in France. "Where I am now stationed is one of the largest repair bases, and I look so far like being here for the duration of the war, but one never can tell. During my knocking about, I have come in contact with several Halley convoys, and everyone in charge of these convoys speaks extremely highly of the lorries under their charge. In the base here we have two in for repairs among about 200 lorries of all makes, and the great bulk of the whole new or nearly new vehicles. That is what always surprises one—the number of new lorries in for repairs—but we have yet to find a Halley new or nearly new, in the repair base. This speaks for itself. The two Halley lorries we have in here are old ones, and have been out since the beginning, taking troops and ammunition to the firing line. One of these was struck by a shell but got very little damaged, the steering gear being bent and one of the wheels blown away, so it has to be thoroughly looked over. It belonged to a Northampton firm, Messrs. Westley Bros. and Clark, and must be several years old. Another one belonged to the Crichton Royal Institute, Dumfries, and is still pulling strong. It has to have the springs set up, as it has been carrying over its load nearly all the time on roads that to see is the only way you can realise. There is nothing anything like them in Britain."

ELECTRIC VEHICLES FOR EDINBURGH.—The Electric Lighting Committee recently received an inquiry as to the probable cost of current for charging electric motor vehicles from a firm which propose to use such cars in their business. The Committee unanimously proposed to recommend that the rates should be 1d. per unit.

FODEN'S STEAM WAGON WORKS.—The recent labour trouble at the works of Messrs. Foden, Limited, at Sandbach, Cheshire, is now happily ended, and the full complement of men is engaged in turning out Foden wagons at normal speed. Messrs. Foden have received large orders from the British Government as well as from our Allies.

NOTTINGHAM OMNIBUSES COMMANDEERED.—In the annual report of the Nottingham Tramways Committee it is stated that two motor omnibuses were ordered, to run between Derby Road terminus and Dunkirk. These vehicles were nearly ready for delivery at the time war was declared, and the chassis were then requisitioned by the military authorities.

NO OMNIBUSES OBTAINABLE.—In response to inquiries as to when the full service of omnibuses will be put on the Oxford routes, the Oxford Tramway Company state that, with the demands of the War Office on the omnibus manufacturers as pressing as ever, it is impossible to get new omnibuses delivered to private firms, and that there is no prospect of this difficulty disappearing.

A CALL TO THE COLOURS.—The latest recruiting appeal to be issued by the London General Omnibus Company takes the form of an arresting panel bill in three colours—black, yellow, and light blue—each colour forming a broad bar in rainbow style. On the variegated ground bold letters give the following message: "Follow the 'buses to the front. The best country route of the year for men. By 'bus to the trenches. Start now." The appeal is striking and should prove effective.

Commer Car Chassis for a War Institution.

Mechanic R. O. Robins, driver of a Commer Car travelling workshop, in service for the British Red Cross Society, Le Havre, writes: "I have all sorts and classes of work to deal with. I am pleased to say my little B.C. continues with her best behaviour; in fact she improves with every run. I can honestly say that I have not put a spanner to her in any shape or form. We did a 200-mile run from Boulogne to here in company with three other ambulances, a Humber, a Vauxhall, and a Metallurgique, and found no trouble in keeping up with them. We had trouble with the Met., and Humber, but soon got over it with my little repair van on the spot. I have had the engine running for days at a stretch driving my lathe, but the engine never runs hot. I may say this is my one pleasure out here, i.e., having a car which gives me no cause for anxiety, otherwise I am having a rough time."

MOTOR TRAFFIC NOTES.

WOMEN OMNIBUS CONDUCTORS AT SOUTHEND.—The Light Railways Committee of Southend Town Council reported to a meeting of Council held on May 18 that they had employed women as conductors on the omnibuses in their service, and that the work was being well done.

THE "SHEFFIELD" MOTOR AMBULANCE.—Sheffield Corporation Tramways Committee have made an appeal to the public in the name of the Lady Mayoress, Mrs. Wilson, to subscribe for the purchase and equipment of a motor ambulance for war service, the motor to be named the "Sheffield," and known as the gift of the city.

ELECTRICAL VEHICLE TIRES.—Edison Accumulators, Limited, of 2 and 3, Duke Street, S.W., announce that their experience of the better wear of tires on electric vehicles enables them to give a guarantee of 12,000 miles within 15 months for tires sold by them for electric vehicles. This announcement is of special interest in view of the fact that the leading manufacturers of solid tires recently decided that such tires would in future only be guaranteed for 10,000 miles within a period of 12 months.

DISINFECTION OF OMNIBUSES.—At a recent meeting of Oldham Corporation Tramways Committee, the question of a serious reduction in the receipts on what is locally known as the Coppice 'bus route was discussed. The chairman stated that he believed the reason why the receipts were down was the occurrence of fever in the Coppice district. People had avoided the 'bus for fear of contagion. The manager, Mr. Dugdale, replied that there was no risk of contagion in any of their tramcars or 'buses. For the past three years their vehicles had been disinfected every night, and recently the solution of carbosine had been strengthened by 50 per cent.

REGULATIONS FOR DRIVING LICENSES IN BOMBAY.—Under the new rules for the regulation of motor traffic proposed to be instituted in Bombay, it is laid down that a person desiring a license to drive must pay a fee of two rupees and satisfy the police that he or she is a competent and careful driver.

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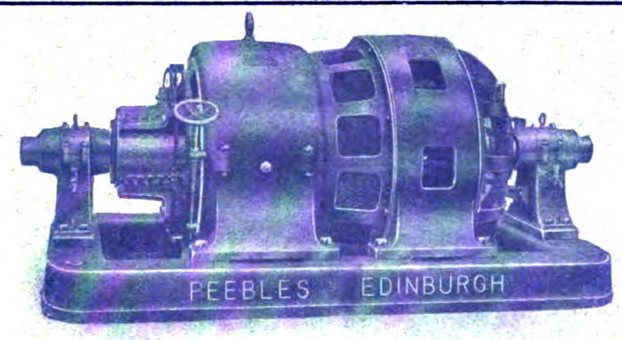

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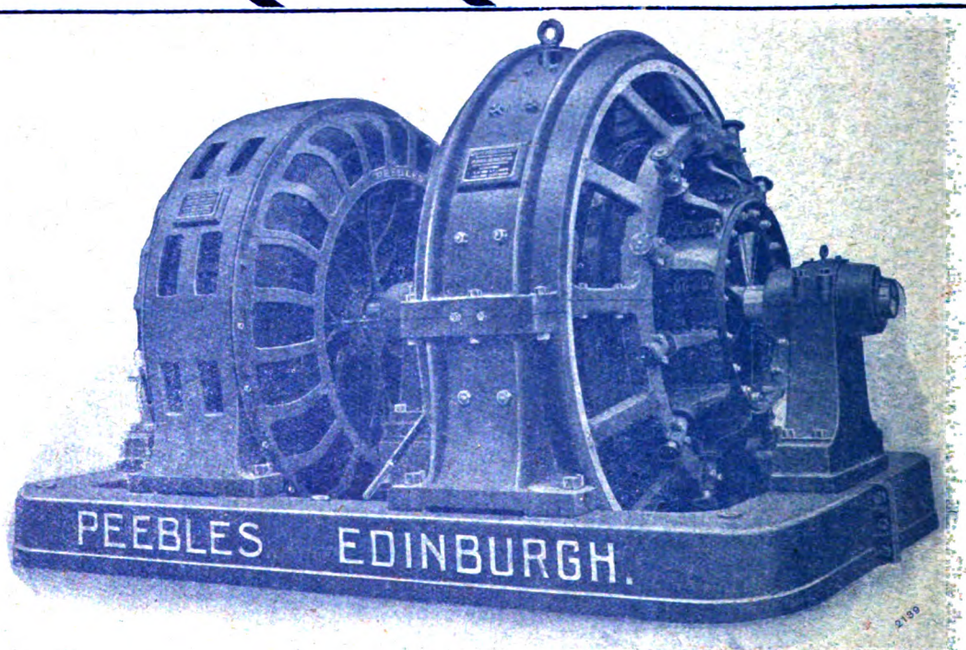

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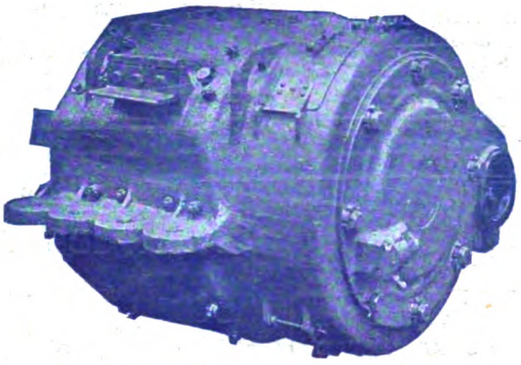
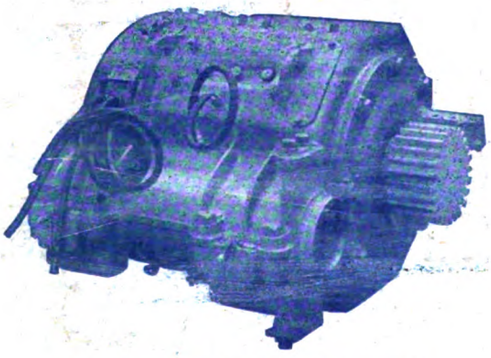
Railway Equipments



Dick, Kerr 250 B.H.P. Railway Motor, view from commutator end.



Dick, Kerr 250 B.H.P. Railway Motor, view from pinion end.

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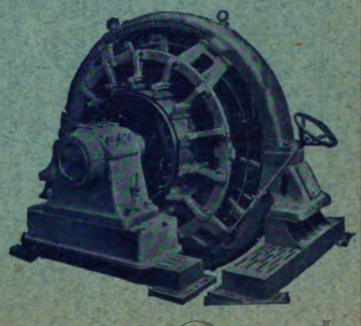

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MAY 13, 1915.
Vol. XXXVII., No. 24.
WITH
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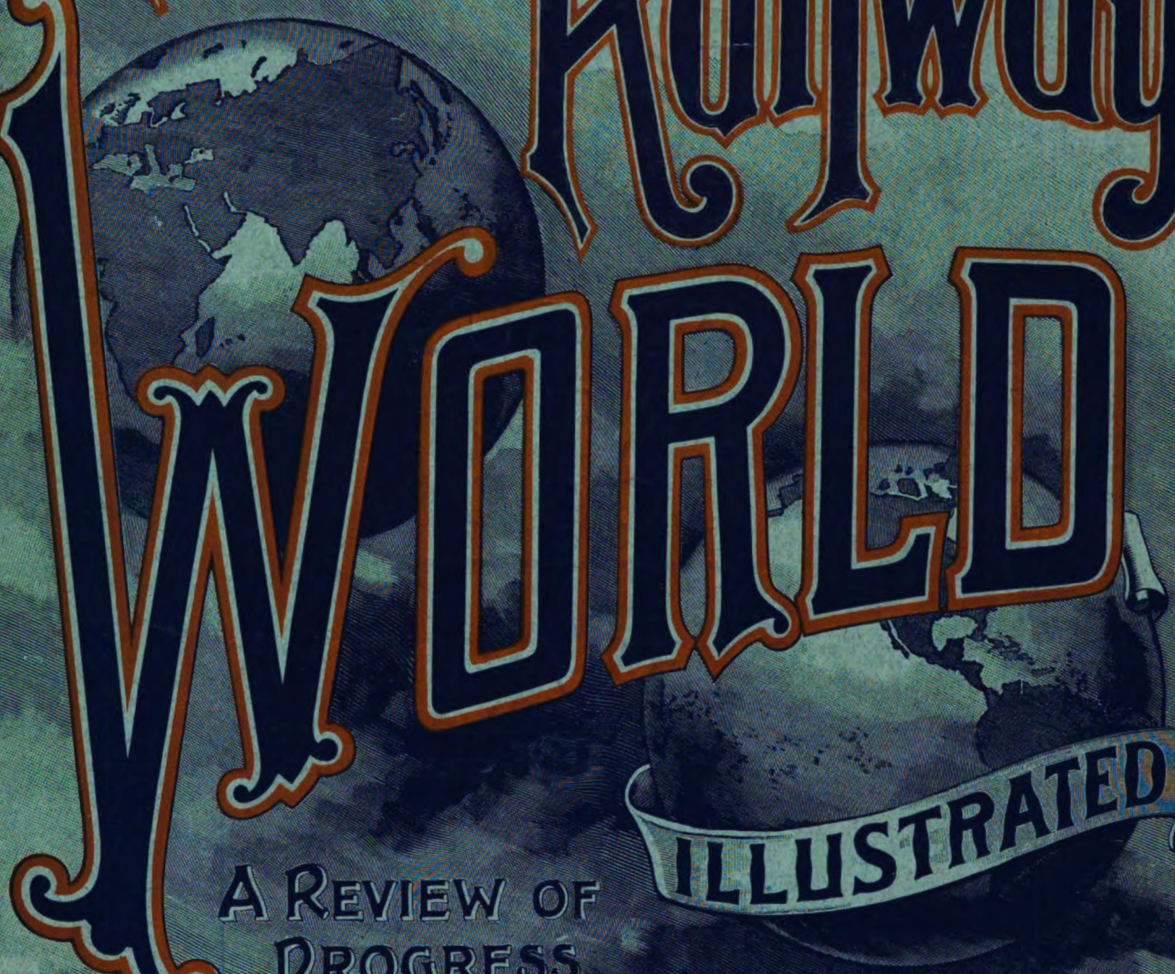

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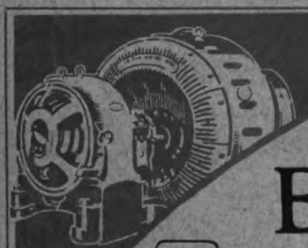

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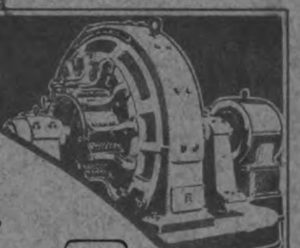

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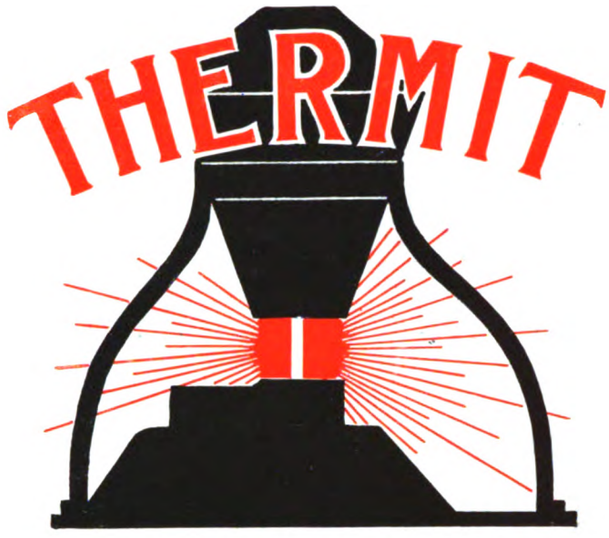

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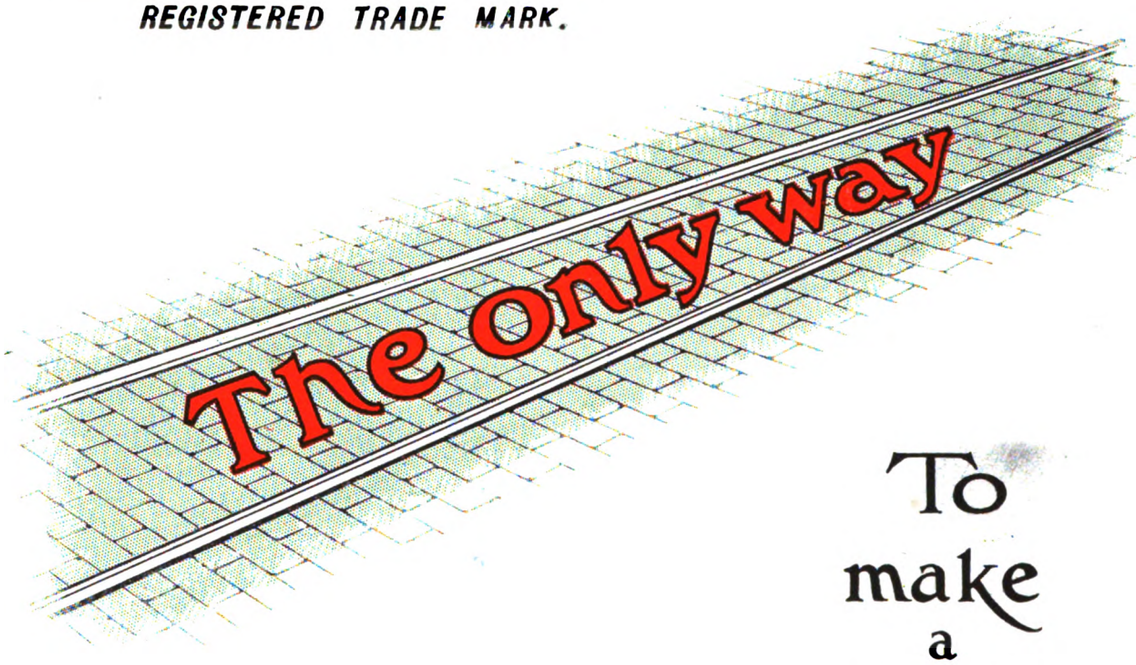

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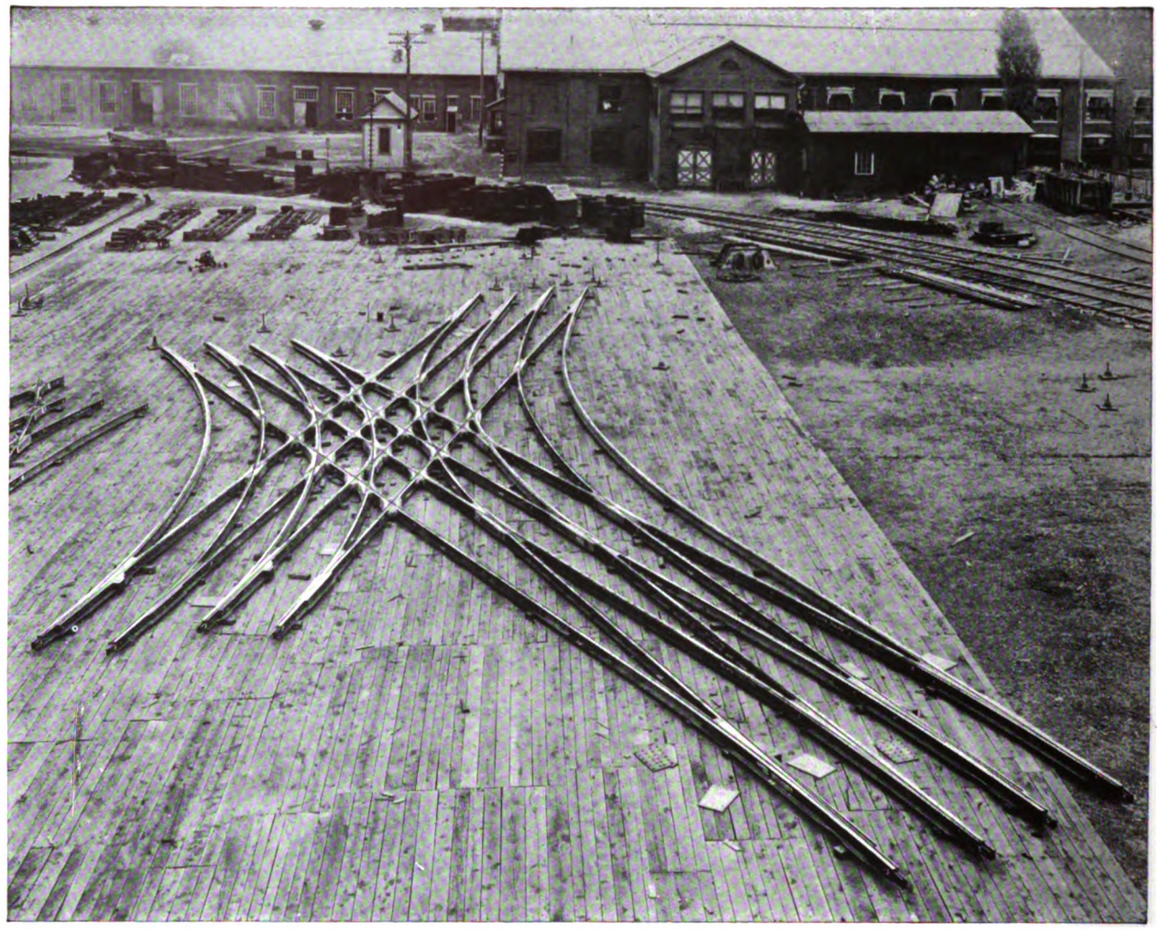

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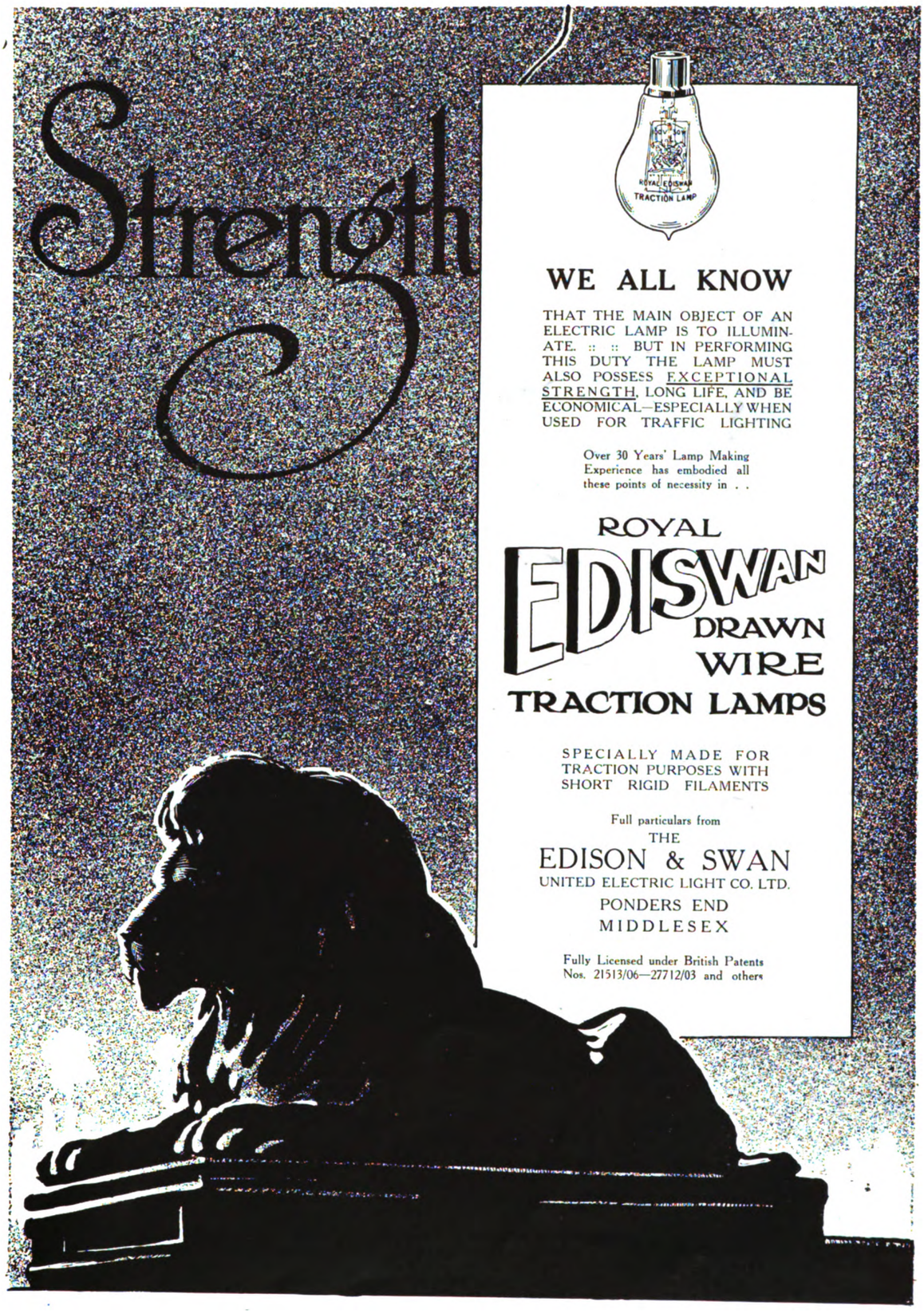
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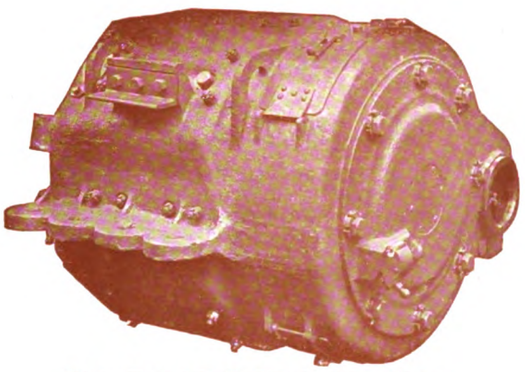
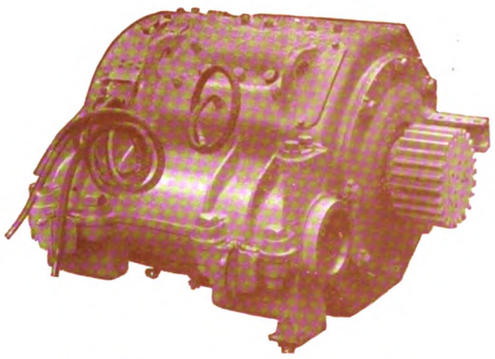


Dick, Kerr 250 B.H.P. Railway Motor, view from commutator end.



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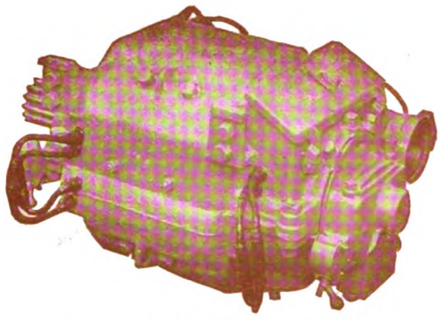

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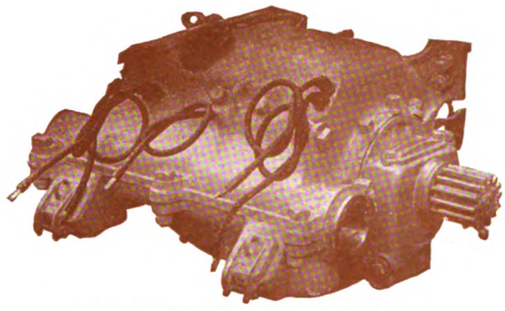

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View from pinion end.

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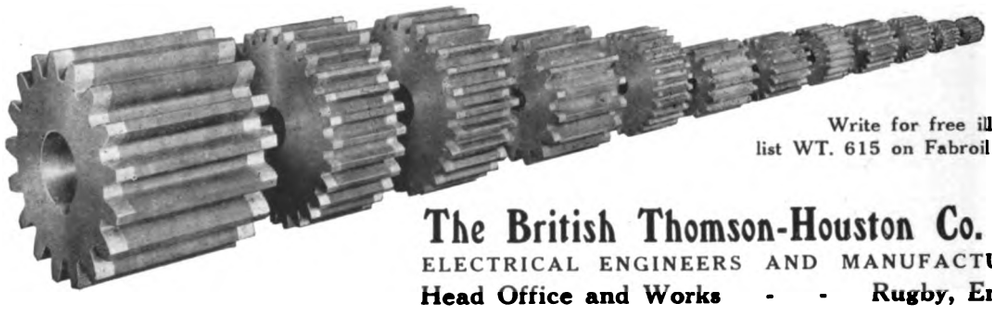

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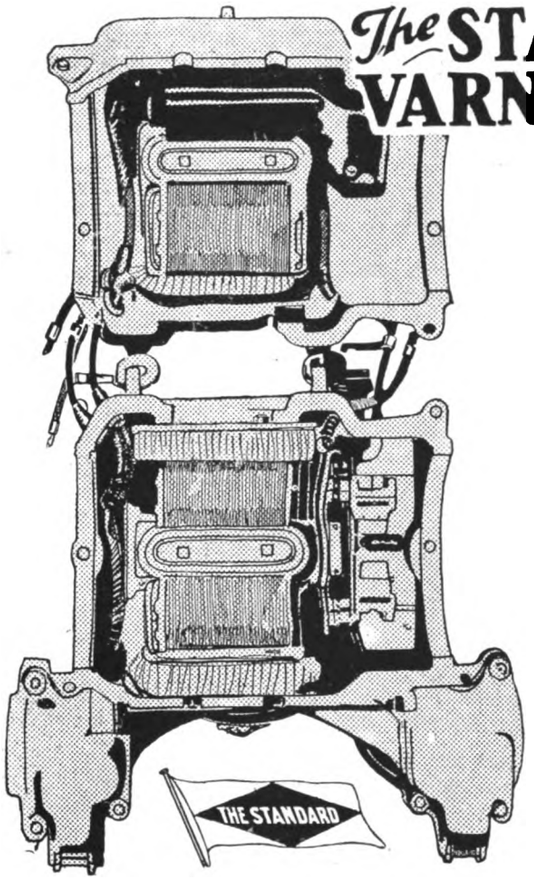

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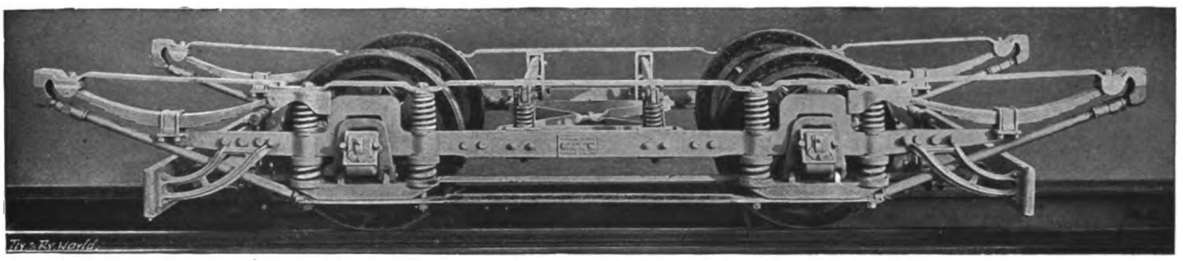

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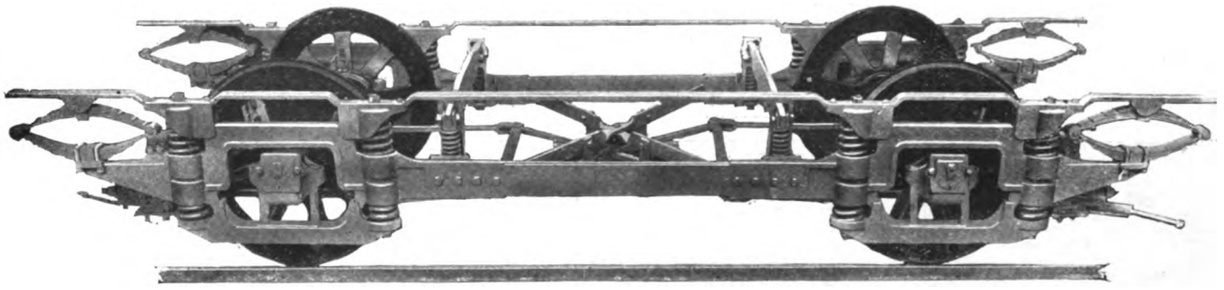

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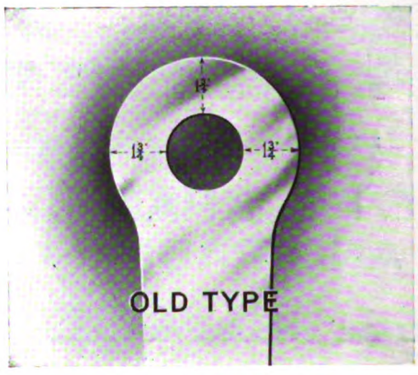

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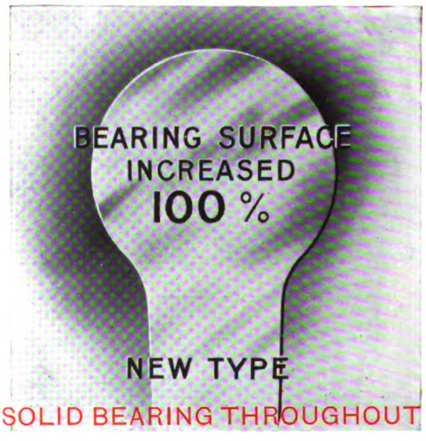

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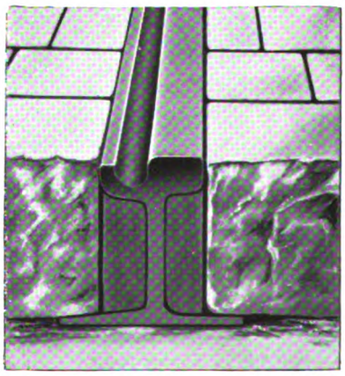

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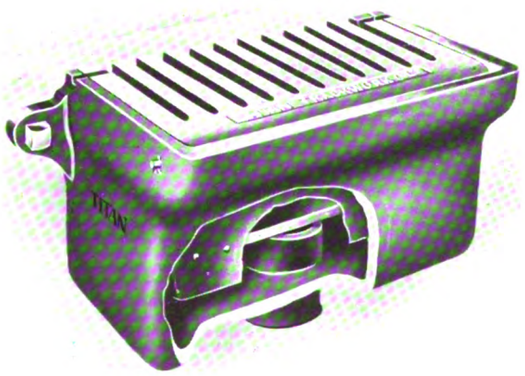

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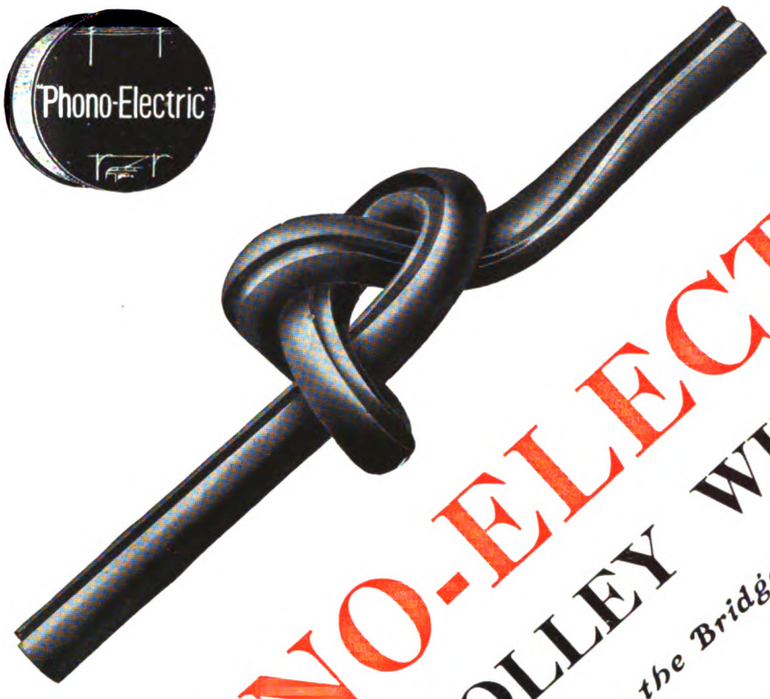

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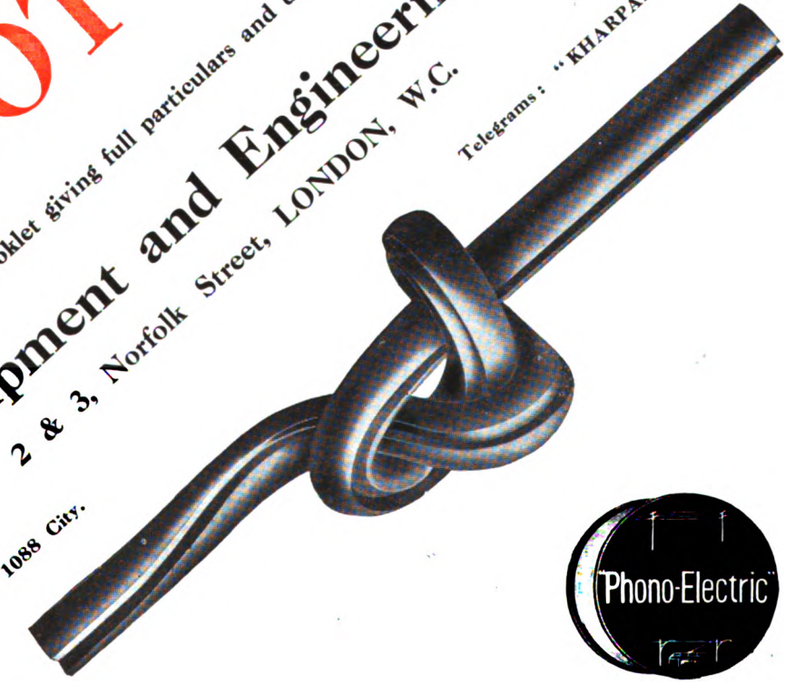

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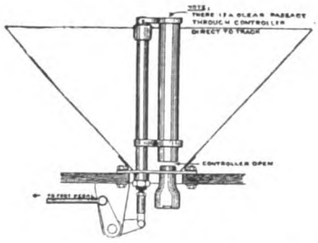

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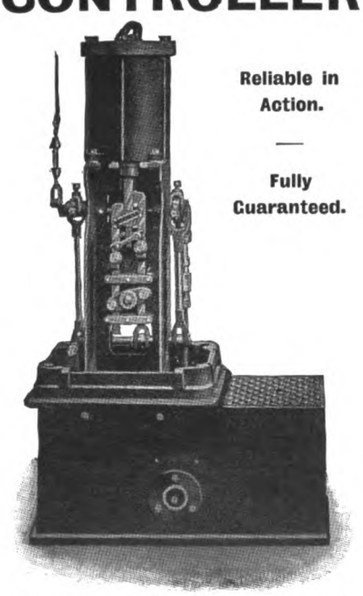

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(Continued on page xx.)

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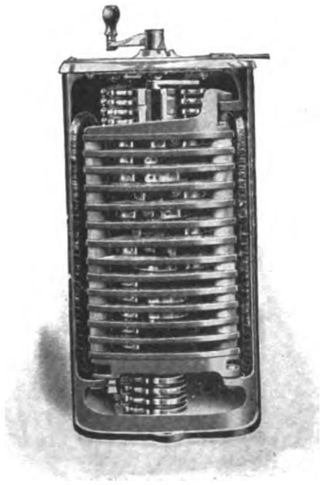

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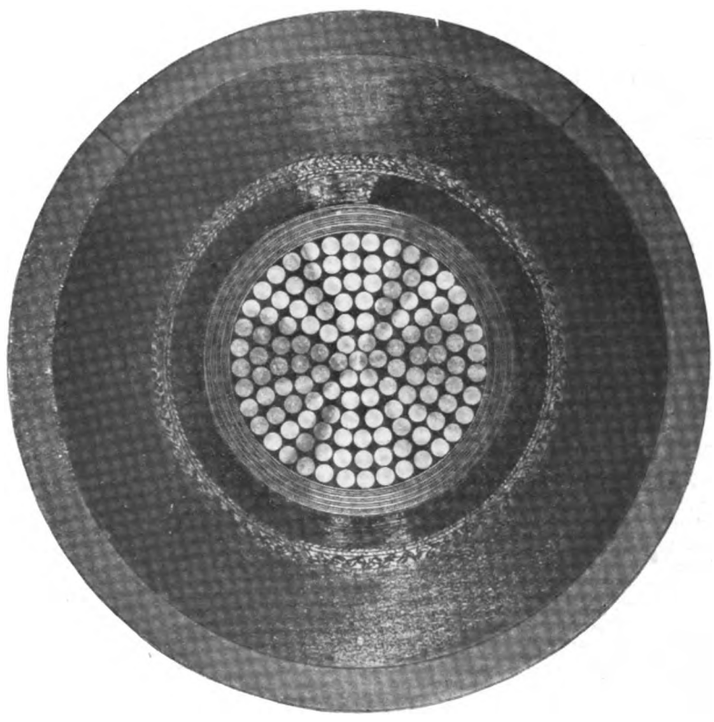

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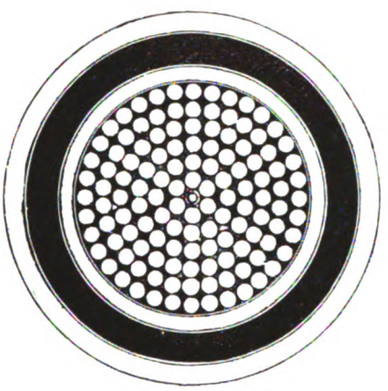

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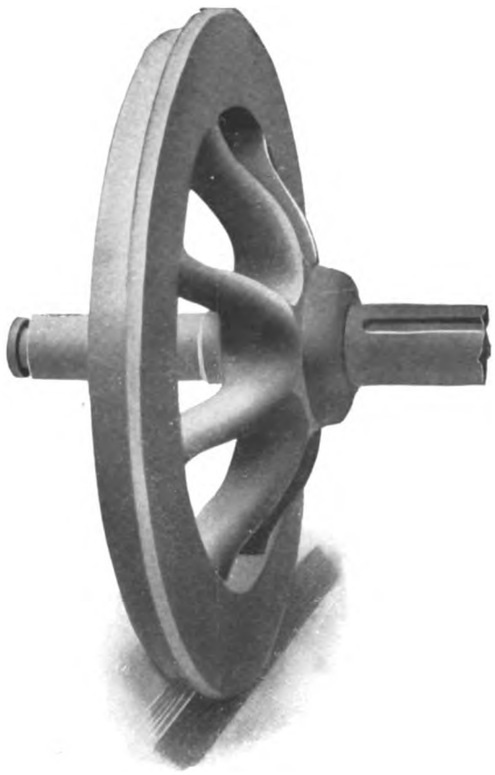

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MUNICIPAL TRAMWAYS, pp. xxiii-xxiv. COMPANY TRAMWAYS, pp. xxiv-xxvi. PARTICULARS OF TRACK AND EQUIPMENT, pp. xxvii-xxx.

TRAMWAY ASSOCIATIONS, p. xxvi.

Aberdare Urban District Tramways, Gadlys Estate, Aberdare. [T.A., Tramways, Aberdare; T.N., 17.] *Gen. Manager and Elec. Engineer*, A. J. Abraham; *Traffic Manager*, H. King; *Chairman Try. Com.*, Coun. Owen Powell.

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Bacup Corporation Tramways.—Town Hall, Bacup, Lancs. *Town Clerk*, J. Entwistle; *Boro' Eng.*, W. H. Elce; *Chairman Try. Com.*, Ald. J. H. Maden; *Vice-Chairman*, Coun. J. H. Lord (Mayor).

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Croydon Corporation Tramways, Tramways Office, Thornton Heath, Surrey. [T.A., Tramways, Croydon; T.N., 406, Croydon.] *Tramways Manager*, T. B. Goodyer; *Chairman Try. Com.*, Ald. G. J. Allen; *Vice-Chairman*, Coun. J. O. Pelton.

Darlington Corporation Tramways, Haughton Road, Darlington. [T.A., Tramways, Darlington; T.N., 135.] *General Manager and Elec. Eng.*, J. R. P. Lunn; *Traffic Manager*, ——————; *Chairman Try. Com.*, Councillor C. W. Starmer.

Dartford Urban District Council Tramways, Dartford. *Chairman Try. Com.*, Coun. S. K. Keyes; *Vice-Chairman*, Coun. R. Bennett.

[Leased. See Dartford Tramways in list of Tramway Companies.]

Darwen Corporation Tramways, Lorne Street, Darwen. [T.N., 104.] *Gen. Manager and Eng.*, F. J. S. Hosken; *Boro. Elec. Eng.*, C. H. Garnett; *Boro. Surveyor and Eng.*, R. W. Smith-Saville; *Chairman Try. Com.*, Ald. Jas. Tomlinson; *Vice-Chairman*, Coun. G. P. Holden.

Derby Corporation Tramways, 4, Victoria Street, Derby. [T.N., 410.] *Gen. Manager*, F. Harding; *Elec. Eng.*, T. P. Wilmshurst; *Per. Way Eng.*, J. Ward; *Chairman Try. Com.*, Coun. J. Dean.

Doncaster Corporation Tramways, Grey Friar's Road, Doncaster. [T.A., Rayner, Doncaster, T.N., 43.] *Manager & Elec. Eng.*, E. S. Rayner; *Chairman Try. Com.*, Coun. P. Stirling (Mayor); *Vice-Chairman*, Coun. Balmforth.

Dover Corporation Tramways, Town Hall, Dover. [T.A., Trams, Dover; T.N., 219 D.] *Gen. Manager*, E. Carden; *Per. Way Eng.*, W. C. Hawke (Boro. Surveyor); *Chairman Try. Com.*, Coun. E. E. Chitty; *Vice-Chairman*, Coun. Barwick.

Dundee Corporation Tramways, Town House Buildings, Dundee. [T.N., 1340]; *Gen. Manager and Eng.*, Peter Fisher; *Elec. Eng.*, H. Richardson; *City Eng.*, J. Thomson; *Chairman Try. Com.*, Coun. G. A. Johnston.

East Ham (Borough of) Corporation Tramways, Nelson Street, East Ham. [T.N., 611 and 100, East Ham.] *Gen. Manager and Elec. Eng.*, W. C. Ullmann *Chairman Try. Com.*, Ald. M. Oakes.

Eccles Corporation Tramways, Eccles. *Elec. Eng.*, H. W. Angus; *Per. Way Eng.*, T. S. Picton; *Chairman Try. Com.*, Ald. W. J. Nuttall, J.P.; *Vice-Chairman*, Coun. Alexander.

[Lines worked by Salford Corporation.]

Erith Urban District Council Tramways, Tramway Depôt, Walnut Tree Road, Erith. [T.A., Tramways, Erith; T.N., 36.] *Gen. Manager and Elec. Engineer*, J. C. Williams; *Cons. Engs.*, Hawtayne and Zeden; *Chairman Try. Com.*, Coun. G. C. Humphreys.

Exeter Corporation Tramways, Paris Street. Exeter. *Manager*, H. C. Bartlett; *Elec. Eng.* H. D. Munro; *Per. Way Eng.*, T. Moulding; *Chairman Try. Com.*, Coun. T. Linscott; *Vice-Chairman*, Ald. H. B. Varwell.

Farnworth Urban District Council Tramways, Albert Road, Farnworth. *Chairman Try. Com.*, Coun. W. B. Richardson; *Vice-Chairman*, Coun. Stones.

[Lines leased to the South Lancashire Tramways Co.]

Glasgow Corporation Tramways, 46, Bath Street, Glasgow. [T.A., Trams, Glasgow; T.N., 1040, Douglas.] *Gen. Manager*, J. Dalrymple; *Traffic Supt.*, L. Mackinnon; *Chief Eng.*, J. Ferguson; *Elec. Eng.*, E. T. Goslin; *Sec.*, J. N. Wilson; *Chairman Try. Com.*, Coun. R. Kirkland; *Vice-Chairman*, Coun. J. Alston.

Gloucester Corporation Light Railway, Bristol Road Depôt, Gloucester. [T.A., Tramways, Gloucester; T.N. 155.] *Gen. Manager and Elec. Eng.*, F. H. Corson; *Chairman Try. Com.*, Coun. J. O. Roberts; *Vice-Chairman*, Coun. C. J. Ramstedt.

Great Yarmouth Corporation Tramways, Caister Road, Great Yarmouth. [T.N. 265.] *Gen. Manager*, F. L. Turner; *Elec. Eng.*, Gordon Bryant *Per. Way. Eng.*, J. W. Cockrill (Borough Surveyor); *Chairman Try. Com.*, Ald. C. A. Campling; *Vice-Chairman*, Coun. J. T. C. Salmon.

Halifax Corporation Tramways, Skircoat Road, Halifax. [T.N., 36 and 382.] *Traffic Manager*, Jas. D. Caird; *Try. Eng.*, J. W. Galloway; *Per. Way Eng.*, J. Lord (Boro. Eng.); *Chairman Try. Com.*, Ald. C. F. Spencer; *Vice-Chairman* Coun. A. Fawcett.

Haslingden Corporation Tramways, John Street, Haslingden. *Gen. Manager and Elec. Eng.*, Barnes Kay; *Per. Way Eng.*, J. S. Green (Borough Surveyor); *Chairman Try. Com.*, Coun. Waddington; *Vice-Chairman*, Coun. Haworth.

Herne Bay Pier Tramway (owned and worked by Herne Bay U.D.C.), Herne Bay. [T.N., 22.] *Res. Eng. and Manager*, H. C. Dufton.

Heywood Corporation Tramways, Heywood, Lancs. [T.N., 37.] *Gen. Manager*, J. Stott; *Per. Way Eng.*, J. A. Settle; *Chairman Try. Com.*, Coun. J. Ashworth; *Vice-Chairman*, Ald. T. Popple, J.P.

Huddersfield Corporation Tramways, Northumberland Street. Huddersfield. [T.N., 698 and 898.] *Gen. Manager & Elec. Eng.*, R. H. Wilkinson; *Assist. Engineer*, A. P. Quilliam; *Traffic Supt.*, T. Hartley; *Borough Eng.*, K. F. Campbell; *Chairman Try. Com.*, Ald. J. H. Aston; *Vice-Chairman*, Coun. J. Barlow.

Hull Corporation Tramways, Alfred Gelder Street, Hull. [T.N., 444, Corporation.] *Manager*, Wm. J. McCombe; *Elec. Eng.*, J. Wilkinson; *Per. Way Eng.*, F. W. Bricknell (*City Engineer*); *Rolling Stock Supt.*, ——————; *Chairman Try. Com.*, Coun. J. H. Hargreaves (Lord Mayor); *Vice-Chairman*, Coun. W. Wheatley.

Ilford Urban District Council Tramways, Ley Street, Ilford. [T.N., 684.] *Manager*, L. E. Harvey; *Traffic Manager*, A. Woolstencroft; *Works Supt.*, H. H. Simpson; *Chairman Try. Com.*, Coun. W J. O. Sheat; *Vice-Chairman*, Coun. Owen Waters.

Ilkeston Corporation Tramways, Park Road Ilkeston. [T.A., Bellamy Ilkeston; T.N., 26.] *Manager and Elec. Eng.*, L. C. F. Bellamy; *Chairman Try. Com.*, Coun. W. Smith; *Vice-Chairman*, Coun. Middleton.

Ipswich Corporation Tramways, Constantine Road, Ipswich. [T.A., Ayton, Tramways, Ipswich; T.N., 354.] *Gen. Manager and Elec. Eng.*, Frank Ayton; *Traffic Supt.*, A. Butler; *Rolling Stock Supt.*, W. A. Fairhead; *Chairman Try. Com.*, Coun. E. C. Ransome; *Vice-Chairman*, W. P. Burton.

Kearsley Urban District Council Tramways, Council Office, Kearsley, Farnworth, S.O. *Clerk U. D. C.*, H. Martin.

[Lines leased to and worked by the South Lancashire Tramways Co.]

Keighley Corporation Tramways, South Street, Keighley. [T.A., Tramways, Keighley; T.N., 17.] *Gen. Manager and Elec. Eng.*, H. Webber; *Chairman Try. Com.*, Coun. A. Smith.

Kilmarnock Corporation Tramways Electricity Works, Kilmarnock. [T.N., 95.] *Elec. Eng. and Manager*, W. C. Bexon; *Consulting Engineers*, Kennedy and Jenkin; *Convener Try. Com.*, Coun. Jones.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Kirkcaldy Corporation Tramways, Electricity Works Victoria Road, Kirkcaldy. [T.A., Tramways, Kirkcaldy. T.N., 124, 174, and 175.] *Manager & Elec. Eng.*, O. F. Francis; *Traffic Manager*, Jas. Fisher; *Chairman Try. Com.*, Coun. G. Fergusson.

Lancaster Corporation Tramways, Electricity Works, Lancaster. [T.A., Milnes, Tramways, Lancaster; T.N., 1, L.] *Gen. Manager & Elec. Eng.*, G. C. Milnes; *Traffic Manager*, W. T. Charlton; *Chairman Try. Com.*, Coun. T. Wilkinson.

Leeds City Tramways, Standard Buildings, City Square, Leeds. [T.A., Tramways, Leeds; T.N., 41 and 169; *General Manager*, J. B. Hamilton; *Traffic Supt.*, A. Daggett; *Elec. Eng.*, John Burbridge; *Per. Way Eng.*, R. B. Holt; *Car Works Supt.*, G. E. Watmough; *Chairman Try. Com.*, Ald. R. A. Smithson; *Vice-Chairman*, Ald. H. Brown.

Leicester Corporation Tramways, 20 and 22, Humberstone Gate, Leicester. [T.N., 2177.] *Manager & Sec.*, A. F. Lucas; *Boro. & Try. Eng.*, E. G. Mawbey; *Elec. Eng.*, T. R. Smith; *Cons. Engs.*, Kincaid, Waller, & Manville; *Chairman Try. Com.*, Ald. S. Flint, J.P.; *Vice-Chairman*, Ald. G. Banton, J.P.

Leith Corporation Tramways, 165, Leith Walk, Leith. [T.N., 415.] *Gen. Manager*, F. A. Fitzpayne; *Per. Way Eng.*, J. R. Findlay (*Burgh Eng.*); *Chairman Try. Com.*, Judge Hall.

Leyton District Council Tramways, Car Depot, Lea Bridge Road, Leyton, E. [T.A., Tramways, Leyton; T.N., 17 Walthamstow.] *Manager*, F. Schofield; *Elec. Eng.*, F. Harman Lewis; *Per. Way Eng.*, E. H. Essex; *Chairman Try. Com.*, Coun. H. Heather.

Lincoln Corporation Tramways, Brayford Side North, Lincoln. [T.A., Stanley Clegg, Lincoln; T.N., 109]. *General Manager and Elec. Eng.*, Stanley Clegg; *Chairman Try. Com.*, Ald. W. S. White; *Vice-Chairman*, Coun. M. A. Ashley (Mayor).

Liverpool Corporation Tramways, 24, Hatton Garden, Liverpool. [T.A., Tramways, Liverpool; T.N., 6054 and 7701, Central.] *General Manager*, C. W. Mallins; *Per. Way Eng.*, J. A. Brodie; *Rolling Stock Supt.*, T. Ridyard; *Chairman Try. Com.*, Coun. E. Russell Taylor; *Vice-Chairman*, Ald. F. Smith, J.P.

London County Council Tramways, 62, Finsbury Pavement, London, E.C. [T.A., Lotram, London; T.N., 3321, 3322, and 3323 London Wall.] *Chief Officer*, A. L. C. Fell; *Deputy Chief Officer*, J. K. Bruce; *Elec. Assist.*, J. Shepherd; *Traffic Assist.*, L. Slattery; *Rolling Stock Supt.*, W. E. Ireland; *Per. Way Eng.*, J. Welling; *Chairman Highways Com.*, G. H. Hume; *Vice-Chairman*, T. Prestige.

Lowestoft Corporation Tramways, Norwich Road, Lowestoft. [T.N., 87.] *Gen. Manager*, H. H. Saunders; *Elec. Eng.*, W. R. May; *Chairman Try. Com.*, Coun. F. Spashett.

Maidstone Corporation Tramways, Tramway Offices, Tonbridge Road, Maidstone. [T.A., Lambert, Tramways, Maidstone; T.N., 72 B.] *Gen. Manager and Elec. Eng.*, A. T. Lambert; *Cons. Eng.*, S. Sellon; *Chairman Try. Com.*, Coun. Lyle; *Vice-Chairman*, Coun. Green.

Manchester Corporation Tramways, 55, Piccadilly, Manchester. [T.A., Tramways, Manchester; T.N., 7800 City.] *Gen. Manager*, J. M. McElroy; *Traffic Sup.*, J. T. Oakes; *Elec. Eng.*, J. J. McMahon; *Chief Civil Eng.*, H. Mattinson; *Rolling Stock Supt.*, G. R. Blackburn; *Chairman Try. Com.*, Ald. J. Bowes *Vice-Chairman*, Coun. A. W. Chapman.

Middlesex County Council Light Railways, Middlesex Guildhall, Westminster, London, S.W. *County Eng.*, H. T. Wakelam, M.I.C.E.; *Chairman of Light Railways Com.*, County Ald. H. Burt; *Vice-Chairman*, County Coun. F. Goodyear.

Middleton Corporation Tramways. *Consulting Engs.*, Lacey, Sillar, and Leigh; *Chairman Try. Com.*, Ald. W. Wood, J.P. (Mayor); *Vice-Chairman*, Ald. Bentley, J.P.
[Worked by Manchester Corporation Tramways.]

Nelson Corporation Light Railways, Charles Street, Nelson. [T.N., 115.] *Manager and Elec. Eng.*, G. F. Nayler; *Per. Way Eng.*, W. Shackleton; *Chairman Try. Com.*, Coun. W. F. Cooke.

Newcastle-upon-Tyne Corporation Tramways, Manors, Newcastle. [T.A., Traction, Newcastle; T.N., 913 and 914 Central.] *Gen. Manager & Engineer*, Ernest Hatton; *Traffic Supt.*, T. Chalder; *Per. Way Eng.*, W. J. Steele; *Chairman Try. Com.*, Ald. J. H. Rodgers; *Vice-Chairman*, Coun. R. Mayne.

Newport (Mon.) Corporation Tramways, Town Hall, Newport, Mon. [T.A., Dynamo, Newport, Mon.; T.N., 990 L., Nat.] *Gen. Manager*, N. J. Young; *Boro. Elec. and Per. Way Eng.*, A. Nichols Moore; *Chairman Try. Com.*, Coun. J. Moxon; *Vice-Chairman*, Ald. F. Phillips.

Northampton Corporation Tramways, St. James', Northampton. [T.N., 279 & 280.] *Gen. Manager and Elec. Eng.*, J. F. Cameron; *Chairman Try. Com.*, Coun. T. D. Lewis; *Vice-Chairman*, Coun. W. Beale.

Nottingham Corporation Tramways, Beastmarket Hill, Nottingham. [Tramways, Nottingham; T.N., 225.] *General Manager & Elec. Eng.*, John Aldworth; *Traffic Supt.*, H. Morley; *Per. Way Eng.*, Arthur Brown (*City Eng.*); *Rolling Stock Supt.*, W. Boot; *Chairman Try. Com.*, Coun. R. H. Swain; *Vice-Chairman*, Ald. F. R. Radford.

Oldham Corporation Tramways, Wallshaw Depot, Oldham. [T.A., Tramways, Oldham; T.N., 1495.] *Gen. Manager & Eng.*, J. W. Dugdale; *Traffic Supt.*, J. Brierley; *Chairman Try. Com.*, Ald. F. G. Isherwood; *Vice-Chairman*, Coun. J. K. Cheetham

Perth Corporation Tramways, Electricity Works, Perth. [T.N., 226 & 101.] *Tramways Manager*, W. G. Snell; *Elec. & Tramways Eng.*, John Lambert; *Per. Way Eng.*, R. McKillop (*Burgh Surv.*); *Chairman Try. Com.*, Coun. Calderwood.

Plymouth Corporation Tramways, 15, Ebrington Street, Plymouth. [T.N. 518, Plymouth.] *General Manager*, C. Everson; *Elec. Eng.*, E. J. Okell; *Chairman Try. Com.*, Ald. S. H. Phillips, J.P.; *Vice-Chairman*, Coun. J. Moon.

Pontypridd Urban District Tramways, Generating Station, Treforest, Pontypridd. [T.N. 33.] *Gen. Manager and Elec. Eng.*, J. E. Teasdel; *Traffic Inspector*, W. May; *Per. Way Eng.*, W. E. Lowe (*Surveyor*); *Chairman Try. Com.*, Coun. Wm. Phillips.

Portsmouth Corporation Tramways, Town Hall, Portsmouth. [T.N., 110 Corporation.] *Gen. Manager*, W. R. Spaven; *Elec. and Per. Way Eng., and Rolling Stock Supt.*, V. G. Lironi; *Traffic Supt.*, W. Munford; *Chairman Try. Com.*, Ald. J. H. Corke, J.P. (Mayor); *Vice-Chairman*, Coun. J. Timpson.

Preston Corporation Tramways, Holmrook Road, Preston. [T.A., Corporation Tramways, Preston; T.N., 278.] *Gen. Manager and Elec. Eng.*, J. F. Simpson; *Traffic Supt.*, E. Lafferty; *Chairman, Try. Com.*, Ald. J. Ormrod; *Vice-Chairman*, Coun. T. Parkinson.

Radcliffe Urban District Council Tramways, Council Offices, Radcliffe, Lancs. *Res. Eng.*, H. Wilkinson; *Per. Way Eng.*, W. L. Rothwell; *Clerk*, S. Mills; *Chairman Try. Com.*, Coun. Walker Allen, J.P.
[These tramways are worked as part of the Bury system.]

Rawtenstall Corporation Tramways, Bacup Road, Rawtenstall. [T.N., 81 and 85.] *Gen. Manager and Elec. Eng.*, C. L. E. Stewart; *Chairman Try. Com.*, Ald. H. Coupe, J.P.; *Vice-Chairman*, Coun. J. W. Stansfield.

Reading Corporation Tramways, Mill Lane, Reading. [T.A., Tramways Manager, Reading; T.N., 330.] *Gen. Manager & Elec. Eng.*, G. F. Craven; *Chairman Try. Com.*, Ald. C. G. Field, J.P.

Rochdale Corporation Tramways, Mellor Street, Rochdale. [T.A., Tramways, Rochdale; T.N., 48.] *Gen. Manager & Eng.*, G. Webster; *Traffic Manager*, R. Bentley; *Rolling Stock Supt.*, E. Sidgwick; *Chairman Try. Com.*, Ald. Taylor.

Rotherham Corporation Tramways, Rawmarsh Road, Rotherham. [T.A., Cross, Rotherham; T.N., 138, 152, and 241.] *General Manager & Elec. Eng.*, E. Cross; *Deputy Elec. Eng.*, J. Williams; *Traffic Manager*, H. Jagger; *Per. Way Eng.*, E. B. Martin; *Rolling Stock Supt.*, C. A. Walker; *Chairman Try. Com.*, Ald. D. L. Winter; *Vice-Chairman*, Coun. T. Reeves.

St. Helens Corporation Tramways, Town Hall, St. Helens, Lancs. *Chairman Try. Com.*, Ald. Sir J. Beecham; *Vice-Chairman*, Coun W. N. Pilkington.
[Lines worked by the New St. Helens and District Tramways Co.]

Salford Corporation Tramways, 32, Blackfriars Street, Salford. [T.A., Tramways, Salford; T.N., 5367 and 5368 Central.] *Gen. Manager*, Geo. W. Holford; *Elec. Eng.*, H. J. Hawkins; *Traffic Supt.*, W. Blakemore; *Per. Way Supt.*, H. Richardson; *Rolling Stock Supt.*, R. Chadwick; *Chairman Try. Com.*, Ald. H. Linsley, J.P.; *Vice-Chairman*, Coun. W. H. Barrett.

Sheffield Corporation Tramways, 8, Division Street, Sheffield. [T.A., Tramways, Sheffield; T.N., 4600.] *General Manager*, A. R. Fearnley; *Elec. Eng.*, H. E. Yerbury; *Traffic Supt.*, A. Handford; *Per. Way Eng.*, W. J. Hadfield; *Rolling Stock Supt.*, J. Smith; *Chairman Try. Com.*, Ald. Sir W. Clegg, J.P.; *Vice-Chairman*, Coun. A. T. Bescoby, J.P.

Shipley Urban District Tramway, Dockfield, Shipley. [T.A., Electricity Works, Shipley; T.N., 190.] *Elec. Eng.*, ; *Chairman Try. Com.*, H. Pitts.
[Lines leased to Bradford Corporation.]

Southampton Corporation Tramways, 161, Above Bar, Southampton. [T.A., Tramways, Southampton; T.N., 301.] *Gen. Manager*, W. T. Robson; *Boro. Elec. Engineer*, H. F. Street; *Traffic Manager*, G. H. Simpson; *Chairman Try. Com.*, Ald. F. A. Dunsford, J.P.

Southend-on-Sea Corporation Tramways, London Road, Southend-on-Sea. [T.N., 96.] *Gen. Manager and Elec. Eng.*, R. Birkett; *Traffic Manager*, J. Daniells; *Per. Way Eng.*, E. J. Elford (*Boro. Surveyor*); *Rolling Stock Supt.*, J. Dobson; *Chairman Try. Com.*, Ald. A. Martin.

Southend Pier Electric Railway, (owned and worked by Southend-on-Sea Corporation). [T.A., Piermaster, Southend; T.N., 91.] Southend-on-Sea. *Elec. Eng.*, C. R. Norton; *Piermaster*, Capt. N. E. Hucker; *Chairman*, Coun. H. Dowsett.

Southport Corporation Tramway, 44, Chapel Street, Southport. [T.N., 116.] *Gen. Manager*, T. J. Kendrew; *Boro' Elec. Eng.*, A. S. Black; *Chairman Try. Com.*, Coun. T. S. Richardson; *Vice-Chairman*, ———.

South Shields Corporation Tramways, Dean Road, South Shields. [T.A., Tramways, South Shields; T.N., 157.] *Gen. Manager & Elec. Eng.*, ———; *Boro. Elec. Eng.*, H. S. Ellis; *Chairman Try. Com.*, Ald. W. G. Wylie; *Vice-Chairman*, Ald. J. W. Henderson.

Stalybridge Hyde, Mossley, and Dukinfield Tramways and Electricity Board, Waterloo Road, Stalybridge. [T.N., 311.] *Commercial Manager*, F. Schofield; *Chief Eng.*, R. Blackmore; *Chairman Try. Com.*, Ald. T. Perrin, J.P.; *Vice-Chairman*, Ald. H. Sykes.

Stockport Corporation Tramways, Mersey Square, Stockport. [T.N., 232 and 237.] *Manager*, A. T. Eardley; *Elec. Eng.*, R. Lomax; *Chairman Try. Com.*, Ald. Chas. Sharples; *Vice-Chairman*, Ald. W. E. Hamnett.

Sunderland Corporation Tramways, Tramway Offices, Monkwearmouth, Sunderland. [T.A., Trys. Manager, Sunderland; T.N., 948.] *Gen. Manager and Elec. Eng.*, A. R. Dayson; *Chairman Try. Com.*, Coun. G. New, J.P.; *Vice-Chairman*, Coun. W. Walker.

Swindon Corporation Tramways, Electricity Works, Swindon. [T.A., Tramways, Swindon; T.N., 4.] *Manager*, T. Medcalf; *Elec. Eng.*, A. Dimmack; *Consulting Engs.*, Lacey, Sillar, & Leigh; *Chairman Try. Com.*, Coun. T. C. Newman; *Vice-Chairman*, Coun. J. J. Shawyer.

Wallasey Corporation Tramways, Seaview Road, Wallasey. [T.A., Tramways, Liscard; T.N., 1131, Liscard.] *General Manager*, R. R. Greene; *Elec. Eng.*, J. H. Crowther; *Per. Way Eng.*, W. H. Travers; *Chairman Try. Com.*, Ald. J. Farley; *Vice-Chairman*, Coun. W. Eastwood.

Walsall Corporation Tramway, St. Paul's Buildings, The Bridge, Walsall. [T.A., Tramways, Walsall; T.N., 238 & 559.] *Gen. Manager*, R. L. Horsfield; *Elec. Eng.*, H. A. Howie; *Per. Way Eng.*, J. Taylor (*Boro. Surveyor*); *Chairman, Try. Com.*, Ald. J. Cope; *Vice-Chairman*, Ald. J. Williams.

Walthamstow Urban District Council Tramways, Chingford Road, Walthamstow. [T.A., Tramways, Walthamstow; T.N., 20.] *Tramways Manager*, W. Murray; *Elec. Eng.*, G. R. Spurr (Priory Avenue, Walthamstow); *Per. Way Eng.*, G. W. Holmes; *Chairman Trys. Com.*, Coun. E. Samuels.

Warrington Corporation Tramways, Mersey Street, Warrington. [T.N., 196] *Gen. Manager*, J. Telfer; *Elec. Eng.*, F. V. L. Mathias; *Chairman Try. Com.*, Coun. Dr. G. W. Joseph; *Vice-Chairman*, Coun. J. Wilkinson.

West Bromwich Corporation Tramway, Electricity Works, West Bromwich. [T.N., 100.] *Boro. Eng.*, A. D. Greatorex; *Boro. Elec. Eng.*, W. A. Jackson; *Chairman Try. Com.*, Ald. A. G. Turley, J.P. (Mayor); *Vice-Chairman*, Coun. G. Garratt.
[These tramways are leased to the South Staffs. (Lessee) Co., Ltd.]

West Ham Corporation Tramways, Greengate Street, Plaistow, London, E. [T.A., Trameurs, Plais., London; T.N., 868 East.] *General Manager*, J. S. D. Moffet; *Boro' Elec. Eng.*, J. W. Beauchamp; *Per. Way Eng.*, J. G. Morley (*Boro. Eng.*); *Chairman Try. Com.*, Ald. H. W. Littler.

West Hartlepool Corporation Tramways, Cleveland Road, West Hartlepool. [T.N., 6073.] *Gen. Manager & Eng.*, Chas. Burgess; *Chairman Try. Com.*, Coun. Martin; *Vice-Chairman*, Coun. Charlton.

Wigan Corporation Tramways, Market Place, Wigan; [T.N., 226.] *Gen. Manager*, F. Buckley; *Per. Way Eng.*, A. T. Gooseman; *Chairman Try. Com.*, Coun. R. Fletcher; *Vice-Chairman*, Coun. J. Walkden.

Wolverhampton Corporation Tramways, Municipal Tramway Offices, Cleveland Road, Wolverhampton. [T.N., 324.] *Gen. Manager*, W. A. Luntley; *Tramways Eng. and Deputy Gen. Manager*, C. O. Silvers; *Boro. Elec. Eng.*, S. T. Allen; *Per. Way Eng.*, George Green; *Chairman Try. Com.*, Ald. Sir C. T. Mander, Bart., J.P.; *Vice-Chairman*, Ald. S. Craddock, J.P.

York Corporation Tramways, 8, Clifford Street, York. [T N., 302]. *Gen. Manager and Elec. Eng.*, J. W. Hame; *Traffic Supt.*, J. W. Horton; *Per. Way Eng.*, F. W. Spurr (City Surveyor); *Chairman Try. Com.*, Ald. S. W. Meyer; *Vice-Chairman*, Coun. S. H. Davies.

COMPANY TRAMWAYS.

Aberdeen Suburban Tramways Company, 15, Golden Square, Aberdeen. [T.A., Judicial, Aberdeen; T.N., 447.] *Manager*, A. Wilkie; *Sec.*, G. Duncan; *Chairman*, James Mearns; *Directors*, W Jackson, Dr. Christie.

Airdrie and Coatbridge Tramways Company, Tramway Depôt, Main Street, Coatbridge [T.N., 105], and Electrical Federation Offices, Kingsway, London, W.C. *Gen. Manager*, A. Robertson; *Sec.*, P. N. Gray; *Chairman*, W. L. Madgen; *Directors*, H. S. Day, A. C. Miles.

Barnsley and District Electric Traction Company, Ltd., Car Depot, Sheffield Road, Barnsley. [T.A., Tramways, Barnsley; T.N., 159.] *Manager and Eng.*, P. H. Marco, A.I.E.E.; *Sec.*, S. M. Wright; *Chairman*, E. Garcke; *Directors*, Col. Sir Thomas Pilkington, Bart., E. A. Paris.

Barrow-in-Furness Tramways, Salthouse Road Depot, Barrow, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Barrow; T.N., 125.] *Manager*, W. F. Bladon; *Sec.*, T. Phillips-Conn; *Chairman*, H. S. Day; *Directors*, J. V. Kitchener, E. R. Soames.

Bath Electric Tramways Company, Ltd., Walcot Street, Bath, and 119-125, Finsbury Pavement, London, E.C. [T.A., Trams, Bath; T.N., 214.] *Gen. Manager and Eng.*, W. E. Hardy; *Traffic Supt.*, E. Seckington; *Sec.*, H. J. Almond; *Chairman*, Hon. Sir J. Sivewright, K.C.M.G.; *Directors*, H. F. Clutterbuck, E. H. R. Trenow, A. A. C. Swinton, E. Callaird.

Bessbrook and Newry Tramway Company, Bessbrook, Co. Armagh. [T.A., Tramways, Bessbrook.] *Manager*, Robert Caven; *Elec. Eng.*, J. L. D. Meares; *Chairman*, J. N. Richardson; *Directors*, C. H. Richardson, R. T. Scott, T. W. Richardson, T. McGreggor Greer.

Birmingham District Power and Traction Company (section of the Birmingham and Midland Tramways Joint Committee), Power Station, Downing Street, Smethwick, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Power Station, Smethwick; T.N., 65 Smethwick.] *Electrical Eng.*, S. A. Mahood; *Gen. Manager*, W. G. Bond; *Secretary*, B. Kingsford; *Chairman*, C. Shirreff Hilton; *Directors*, J. A. Lycett, W. L. Madgen, S. R. Blundstone.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Blackpool and Fleetwood Tramroad Company, Ltd., Bispham, near Blackpool. [T.A., Cameron, Blackpool; T.N., 121.] *General Manager and Secretary*, J. Cameron; *Elec. Eng.*, A. Cameron; *Chairman*, John Greenwood; *Directors*, R. H. Prestwich, R. B. Barningham, R. S. Boddington, G. Richardson, G. Readman.

Blackpool and Fylde Light Railway Company, 5, Clifton Street, Blackpool. (No appointment of engineer or officials yet made.) *Secretary*, R. Bibby; *Chairman*, John Greenwood; *Directors*, T. Fisher, J.P., John Platt, J.P., W. Hardman, J.P., R. H. Mabbott.

Blackpool, St. Anne's, and Lytham Tramways Company, Ltd., Squires Gate, and 30, Birley Street, Blackpool. [T.N., 327 and 22]. *Gen. Manager and Elec. Engr.*, H. W. Laing; *Traffic Manager*, G. W. Wood; *Rolling Stock Supt.*, J. Partington; *Secretary*, Chas. E. Riding; *Chairman*, G. Nicholson; *Directors*, T. M. Smith, T. Preston.

Bray and Enniskerry Railway Company, 52, Westland Row, Dublin. *Sec.*, M. F. Keogh; *Chairman*, A. Killingley; *Director*, F. M'Crea.

Brighton Beach Electric Railway, Madeira Road, Brighton. [T.A., Volk, Brighton; T.N., 14 P.O.] *Manager and Eng.*, M. H. Volk; *Traffic Superintendent*, H. Sheppard; *Per. Way Eng.*, J. Barker; *Secretary*, A. Volk; *Chairman*, M. Volk; *Directors*, M. H. Volk, B. W. Symonds.

Bristol Tramways and Carriage Company, Ltd., Clare Street House, Bristol. [T.A., Cab, Bristol; T.N., 74 & 3074 Nat.] *Manager*, Chas. Challenger; *Assist. Manager*, S. E. Smith; *Electrical Engineer*, W. H. Munton; *Permanent Way Engineer*, G. T. C. Edwards; *Secretary*, H. F. Cooper; *Chairman*, Sir G. White, Bart.; *Directors*, W. G. Verdun Smith (*Managing*), S. White, J.P., J. H. Howell, J.P., G. Stanley White.

British Electric Traction Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C. E. Garcke (*chairman*); *Directors*, C. Shirreff B. Hilton, W. L. Madgen, J. S. Raworth, G. T. Symons, C. G. Tegetmeier, P. D. Tuckett, G. Cornwallis West; *Joint Managers*, C. H. Dade and R. J. Howley; *Acting Secretary*, T. Bower; *Accountant*, C. Walmsley.

This company is interested in the following tramways, particulars of which are given under their respective names:

Airdrie & Coatbridge.
Barnsley & District.
Barrow-in-Furness.
Birmingham & District Power & Traction Co.:
Birmingham & Midland
Dudley, Stourbridge, & District.
South Staffordshire.
Wolverhampton Dist.
Devonport & District.
Gateshead & District.
General Elec. Tramways.
Gravesend & Northfleet.
Greenock & Port Glasgow.
Jarrow & District.
Kidderminster & District.
Merthyr.
Metropolitan.
Middleton.
North Staffordshire.
Oldham, Ashton, & Hyde.
Peterborough.
Potteries.
Rothesay.
Sheerness & District.
South Metropolitan.
Southport.
Swansea.
Taunton.
Tynemouth & District.
Weston-super-Mare & District.
Worcester.
Wrexham & District.
Yorkshire (Woollen Dist.)

Burton and Ashby Light Railways, Power Station, Swadlincote, nr. Burton-on-Trent. [T.A., Toulmin, Swadlincote; T.N., 1.] *Manager and Eng.*, Jas. Toulmin; *Secretary*, A. L. Charles; *Chairman*, G. Murray Smith.

[The line is owned and worked by the Midland Railway Company.]

Camborne and Redruth Tramways, Elec. Works, Carn Brea, R.S.O., Cornwall. [T.N., 3, Camborne.] (Owned by Urban Elec. Supply Co.) *Manager and Eng.*, L. A. Hards; *Sec.*, C. H. Jones; *Chairman*, P. D. Tuckett; *Directors*, E. Charrington, H. B. Grotian, Douglas Owen.

Carlisle Tramways Company, Ltd., City of, Depot and Offices, London Road, Carlisle. [T.A., Tramways, Carlisle; T.N., 0180.] *Engineer and Manager*, R. L. McCulloch.

Chatham and District Light Railways Company, Luton Road, Chatham, and 83, Cannon Street London, E.C. [T.A., Tramways, Chatham; T.N., 51.] *General Manager*, W. Jensen; *Assist. Manager*, J. C. Whiteley; *Traffic Manager*, W. G. Davis; *Secretary*, A. Clements; *Chairman*, A. R. Monks; *Directors*, H. C. Levis, J. F. Nauheim, W. B. H. Martindale.

Cheltenham and District Light Railway Company, Cheltenham. [T.N., 341.] *Directors*, A. H. Beatty (*Chairman*), W. Shearer, H. L. Williams, A. S. Guinness, H. J. McCormick; *Sec.*, Wm. C. Bryden, C. A., 66, Queen Street, London, E.C.; *Local Eng. and Manager*, Henry J. McCormick, St. George's Road, Cheltenham.

Clontarf and Hill of Howth Tramroad Company, 39, Dame Street, Dublin. [T.A., c/o Railways, Dublin; T.N., 917.] *Secretary*, J. P. Chapman; *Chairman*, W. L. Murphy; *Directors*, E. Anderson, J. J. Dudley.

Cork Electric Tramways and Lighting Company, Ltd., Albert Street, Cork. [T.A., Tramways, Cork; T.N., 78 and 535.] *Manager and Engineer*, H. H. Nalder; *Traffic Manager*, H. G. Whiting; *Per. Way Engineer*, H. Mack; *Secretary*, A. Clements; *Chairman*, A. R. Monks; *Directors*, E. Anderson, W. M. Murphy, W. B. H. Martindale, H. C. Levis.

Dartford Urban District Council Tramways, Car Depot, Priory Road, Dartford. [T.N., 31 Dartford.] (Leased to and worked by Balfour, Beatty, & Co., Ltd., 22a, College Hill, London, E.C. *Gen. Manager and Engineer*, D. N. R. Bruce.

Devonport and District Tramways Company, Tramway Depot., Milehouse, Devonport, and Electrical Federation Offices, London, W.C. [T.A., Head Office, Devonport c/o Tramway, London; T.N., Head Office, Holborn 2686. T.A., Tramways, Milehouse, Devonport; T.N., 62.] *Manager and Eng.*, George Cardwell; *Secretary*, S. M. Wright; *Chairman*, C. S. B. Hilton; *Directors*, J. S. Raworth, E. R. Soames, C. G. Tegetmeier.

Dewsbury, Batley, and Birstall Tramways Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C.

[Lines worked by Yorkshire (Woollen District) Electric Tramways, Ltd., *q.v.*]

Dewsbury and Ossett Corporation and Soothill Nether Urban District Council Tramways, (Lessees: The National Elec. Construction Co., Ltd., 3, Laurence Pountney Hill, London, E.C.) [T.A., Overhauled, London; T.N., 5329 and 5330 Bank.] *Manager*, W. MacGibbon.

Douglas—Ramsey, (The Manx Elec. Rly. Company), 1, Strathallan Crescent, Douglas. (See Manx Electric Railway Company).

Douglas Southern Electric Tramways, Ltd., Marine Drive, Douglas, Isle of Man, and 24, Brazennose Street, Manchester. [T.A., Traffic, Douglas.] *Manager and Eng.*, R. Orton; *Sec.*, J. E. Sharples; *Chairman*, T. J. Hutchinson; *Directors*, I. E. Winslow, E. A. Hopkins.

Dublin and Lucan Electric Railway Company, 15, Conyngham Road, Dublin. [T.A., Lucan Tramway, Dublin; T.N. 2282 and 4006 Dublin, and 5 Lucan.] *Manager, Elec. Eng., and Sec.*, D. McDowall Grosart; *Chairman*, J. W. Hill; *Vice-Chairman*, Capt. C. C. Vesey; *Directors*, E. Anderson, H. B. Coyle.

Dublin United Tramways Company (1896), Ltd., 9, Upper Sackville Street, Dublin. [T.A., Tramways, Dublin; T.N., 58 and 59.] *Manager*, ; *Elec. Eng.*, G. M. Harriss; *Con. Eng.*, H. F. Parshall; *Per. Way Eng.*, P. F. O'Sullivan; *Secretary*, ; *Chairman*, W. M. Murphy; *Directors*, W. F. Cotton, Capt. C. N. Colthurst Vesey, J. Mooney.

Dudley, Stourbridge and District Electric Traction Company, Ltd. (Section of The Birmingham and Midland Tramways Joint Committee), Power Station, Downing Street, Smethwick, Brierley Hill, Staffs., and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 65 Smethwick.] *General Manager*, W. G. Bond; *Secretary*, E. H. Woodhall; *Chairman*, S. R. Blundstone; *Directors*, J. A. Lycett, W. G. Bond.

Dumbarton Burgh and County Tramways Company, Tramway Depot, Dumbarton, and 28, Rutland Street, Edinburgh. [T.A., Tramways, Dumbarton; T.N., 119.] *Gen. Manager and Elec. Eng.*, J. P. McMahon; *Secretary*, J. Dishart; *Chairman*, G. Balfour; *Directors*, K. Sanderson, K. A. Scott Moncrieff.

Dundee, Broughty Ferry & District Tramways Company, Milton, Monifieth, N.B. [T.N., 24 Monifieth.] *Gen. Manager & Engineer*, Daniel Fisher; *Secretary*, E. Cowan; *Chairman*, W. Brownlee; *Directors*, Geo. Balfour, D. W. Wybrants, David Hynds.

Dunfermline and District Tramways Company, Tramway Depot, Cowdenbeath, Fife, and 8, New Row, Dunfermline. *Manager and Engineer*, J. H. Shepherd; *Secretary*, G. A. Nicolson; *Cons. Engs.*, Hawtayne & Zeden; *Directors*, Wm. Loy, G. Balfour (*managing*), K. Sanderson, D. Hynd.

Falkirk & District Tramways Company, Larbert Road, Larbert, Stirlingshire. [T.A., Tramways Co., Falkirk; T.N., 154 Falkirk.] *Gen. Manager and Engineer*, D. Hays; *Chairman*, G. M. Brown; *Directors*, A. W. Tait, R. Hunter, G. Balfour, C. D. Geddes.

Felixstowe Pier Railway, Felixstowe. (The Coast Development Corporation, Ltd.) *Elec. Eng.*, E. A. Lambert.

Gateshead and District Tramways Company, Tramway Depôt, Sunderland Road, Gateshead, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramway Depôt, Gateshead; T.N., 125 & 408 Gateshead.] *General Manager*, William Morrison; *Directors*, H. A. Stagg, C. S. B. Hilton (*deputy chairman*), L. A. Atherley-Jones, K.C., H. S. Day.

Giant's Causeway and Portrush Electric Tramway Company, Portrush. *Manager & Sec.*, D. Fall; *Elec. Eng.*, W. A. Traill; *Chairman*, A. Traill; *Directors*, C. M'D. Stuart, J. S. Moore, W. A. Traill.

Glossop Tramways, Electricity Works, Glossop (owned by the Urban Electric Supply Co.) [T.N., 34, Glossop.] *Manager and Res. Eng.*, C. E. Knowles; *Rolling Stock Supt.*, A. W. Bullough; *Secretary*, C. H. Jones; *Chairman*, P. D. Tuckett; *Directors*, E. Charrington, F. E. Gripper, H. B. Grotrian, D. Owen.

Gosport and Fareham Tramways, Tramways and Lighting Office, Gosport, Hants., and Moorgate Station Chambers, London, E.C. [T.A., Tramways, Gosport; T.N., 3, National, Gosport, and 16, Municipal, Gosport.] *Eng. and Manager*, J. Fereday Glenn; *Sec.*, J. Barber Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Directors*, J. Barber Glenn (*managing*), S. Hern.

Gravesend & Northfleet Electric Tramways, Ltd., Tramway Depot, Northfleet, Kent, and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 958, Gravesend.] *Manager & Sec.*, P. N. Gray; *Chairman*, W. L. Madgen; *Directors*, J. F. Albright, W. S. Wreathall.

Great Crosby Tramways, 31, James Street, Liverpool.

[This tramway is worked by the Liverpool Overhead Railway Company.]

Great Grimsby Street Tramway Co., Southampton House, Cleethorpes, and Moorgate Station Chambers, London, E.C. [T.A., Blanco, Cleethorpes; T.N., 16.] *Manager and Eng.*, H. L. White; *Elec. Eng.*, H. O. White; *Managing Director and Secretary*, J. B. Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Director*, S. Hern.

Greenock and Port Glasgow Tramways Company, Ladyburn, Greenock, and Electrical Federation Offices, Kingsway, London, W.C. [T.A. Tramways, Greenock; T.N., 562]. *Manager*, A. Robertson; *Secretary*, W. F. Herring; *Chairman*, W. L. Madgen; *Directors*, G. J. Somerville, A. C. Miles, H. S. Day.

Guernsey Railway Company, Ltd., Hougue-à-la-Perre, Guernsey. *Manager and Elec. Eng.*, Arthur G. Bird; *Sec.*, J. de Mouilpied; *Chairman*, G. F. Peek; *Directors*, W. D. Murdoch, E. Valied, J. B. Collings, Q. Le Pelley.

Hampshire Light Railway (Electric) Company, Ltd., Moorgate Station Chambers, London, E.C. *Secretary*, J. B. Glenn; *Chairman*, A. Beattie, J.P.; *Directors*, J. Barber Glenn (*managing*), S. Hern.

[This company works the Portsdown and Horndean Light Railway.]

Hastings Tramways Company, Ltd., Beaufort Road, Silverhill, St. Leonards-on-Sea, and 1, Queen Victoria Street, London, E.C. [T.A., Tramways, Hastings, and Enshrine, London; T.N., 90 Hastings, and 3465, City]. *General Manager and Elec. Eng.*, W. V. Edwards; *Secretary*, W. R. Elston; *Cons. Engs.*, Kincaid, Waller, Manville, and Dawson; *Chairman*, G. Kitchen; *Directors*, E. C. Morgan, J. C. Williamson, Dr. Moody.

Imperial Tramways Company, Ltd., Clare Street House, Bristol. *Secretary*, W. G. Verdon Smith; *Manager*, F. Freshwater; *Chairman*, Sir George White, Bart.; *Directors*, H. C. Godfray, J. H. Howell, S. White.

Isle of Thanet Electric Tramways and Lighting Company, Ltd., St. Peter's, Kent, and Moorgate Station Chambers, London, E.C. [T.A., Tramways, St. Peters, Kent; T.N., 29 Broadstairs]. *Gen. Manager and Elec. Eng.*, J. A. Forde; *Traffic Supt.*, A. L. Gardener; *Secretary*, J. Barber Glenn; *Chairman*, A. R. Monks; *Directors*, Lord Arthur Butler, W. M. Murphy, H. Brown.

Jarrow and District Electric Traction Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C. [T.A., Jarrow, c/o Tramway, London; T.N., 2686 Holborn.] *Traffic Manager*, G. McClelland; *Secretary*, C. W. Francis; *Chairman*, G. J. Somerville; *Directors*, W. Morrison (*managing*), H. S. Day.

Kidderminster & District Electric Lighting and Traction Co., Ltd., Kidderminster and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 108]. *Managing Eng.*, A. Wray *Secretary*, B. Kingsford; *Chairman*, C. S. B. Hilton; *Directors*, J. A. Lycett (*managing*), S. E. Garcke, H. S. Day.

Kinver Tramway, Kinver, and Electrical Federation Offices, Kingsway, London, W.C., *q.v.*, Dudley, Stourbridge, and District Elec. Traction Co., Ltd.

Lanarkshire Tramways Company, Edinburgh Road, Motherwell, N.B., and 83, Cannon Street, London, E.C. [T.A., Tramways, Motherwell; T.N., 64.] *Gen. Manager and Eng.*, G. F. Moller; *Elec. Eng.*, E. H. Glennie; *Per. Way Eng.*, R. Foster; *Traffic Supt.*, J. L. White; *Sec.*, A. Clements; *Chairman*, A. R. Monks; *Directors*, Sir B. Cunard, H. C. Levis, W. H. Whaite, G. Franklin, J. F. Nauheim.

Lancashire United Tramways Limited, Atherton, Lancs. [T.A., Tramways, Atherton; T.N., 36, Atherton.] *Gen. Manager*, E. H. Edwardes; *Secretary*, H. P. Conibear; *Chairman*, Hon. A. Stanley, M.P.; *Directors*, J. M. Henderson, M.P., Sir J. Beecham, J.P., R. Watson, J.P., A. Adam, J. S. Austen.

Liverpool and Prescot Light Railway.—This line, which with the St. Helens Tramways forms the connecting link between the City of Liverpool and South Lancashire Tramways, is owned and worked by the Lancashire United Tramways, Ltd.

Liverpool Overhead Railway Company, 31, James Street, Liverpool. [T.A., Motor, Liverpool; T.N., 5463 Central.] *Gen. Manager and Eng.*, E. J. Neachell; *Secretary*, W. H. Alexander; *Chairman*, H. C. Woodward; *Directors*, J. E. Anderson, G. D. Killey J. U. Hodgson, M. H. Maxwell.

Llandudno and Colwyn Bay Electric Railway, Limited, Tramway Depôt, Rhôs-on-Sea, Colwyn Bay, and Basildon House, Moorgate Street, London, E.C. *Gen. Manager*, Alex. G. Balfour; *Secretary*, A. W. R. Lovering; *Directors*, G. Balfour, A. W. Tait, T. Stoker.

London United Tramways Ltd., Electric Railway House, Broadway, Westminster, London, S.W. [T.N., 6800, Victoria.] *Managing Director*, J. Devonshire; *Secretary*, A. L. Barber; *Gen. Manager and Eng.*, A. H. Pott; *Chairman*, W. M. Acworth; *Directors*, Rt. Hon. Viscount Knutsford, Sir A. H. Stanley, F. V. Schuster.

Luton Corporation Tramways (leased to and worked by Balfour, Beatty & Co., Ltd., 22a, College Hill, London, E.C.), Tramway Offices, Park Street, Luton. [T.N., 230.] *Engineer and Manager*, H. G. Merrick.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Mansfield & District Light Railway Co., Sutton Road, Mansfield. [T.A., Cars, Mansfield, T.N., 107.] *Gen. Manager and Sec.*, C. R. Walker; *Chairman*, A. R. Holland; *Directors*, W. I. Chadburn A. H. Beatty, G. Balfour.

Manx Electric Railway Company, Ltd., 1, Strathallan Crescent, Douglas, Isle of Man, and 3, Finch Lane, London, E.C. [T.A., Electric, Douglas, Man.; T.N., 61.] *Gen. Manager & Eng.*, F. Edmondson; *Secretary*, C. A. Huni; *Chairman*, Col. Sir A. Griffith Boscawen; *Directors*, Sir W. H. Vaudrey, B. E. Greenwell, E. Schenk.

Merthyr Electric Traction and Lighting Company, Ltd., 53, Pontmorlais Circus, Merthyr, and Electrical Federation Offices, Kingsway, London. W.C. [T.A., Tramway Company, Merthyr; T.N., 0180, Merthyr Tydfil.] *Managing Eng.*, L. W. Dixon; *Traffic Supt.*, H. King; *Sec.*, S. J. Clements. *Chairman*, G. J. Somerville; *Directors*, C. G. Tegetmeier, W. L. Madgen, E. R. Soames.

Metropolitan Electric Tramways, Limited, Electric Railway House, Broadway, Westminster, London, S.W. [T.A., Metrolito, London; T.N., 6800, Victoria.] Manor House Offices, Seven Sisters Road, N. [T.A., Lentiscus, London; T.N., 77 Tottenham.] *Gen. Manager and Eng.*, A. H. Pott; *Traffic Manager*, W. E. Hammond; *Secretary*, A. L. Barber; *Chairman*, E. Garcke; *Directors*, Sir E. Spencer, W. L. Madgen, C. G. Tegetmeier, J. Devonshire (*Managing Director*).

Mexborough and Swinton Tramways Company, Electricity Works, Rawmarsh, Yorks. [T.N., 266], and 3, Laurence Pountney Hill, Cannon Street, London, E.C. *Manager and Eng.*, P. Priestly; *Cons. Elec. Eng.*, F. E. Stanley; *Commercial Manager*, Wm. T. Mitchell; *Traffic Supt.*, M. McLeod; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Director (Managing)*, W. B. Cownie, C.A.

Middlesbro, Stockton, and Thornaby Electric Tramway, Bridge Road, Stockton-on-Tees, and Clare Street House, Bristol. [T.A., Tramways, Stockton; T.N., 129.] *Manager*, F. Freshwater; *Secretary*, W. G. Verdon Smith; *Chairman*, Sir Geo. White, Bart.; *Directors*, H. C. Godfray, S. White, H. C. Doggett.

Middleton Electric Traction Company, Hiltonfold Lane, Middleton, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramway Depot, Middleton; T.N., 37 Middleton.] *Gen. Manager*, W. F. Endean; *Secretary*, W. E. Woodroofe; *Chairman*, Lord Vaux of Harrowden; *Directors*, J. V. Kitchener, W. S. Wreathall.

Musselburgh and District Electric Light and Traction Co., Ltd., High St., Musselburgh, N.B. [T.A., Tramways, Musselburgh; T.N., 115.] (Registered Office, 3, Laurence Pountney Hill, London, E.C. [T.N., 5329 and 5330, Bank.]) *Manager*, R. Watson; *Resident Engineer*, J. L. Winter; *Traffic Inspector*, W. Scott; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Directors*, B. Bernheim, J. Anderson, W. B. Cownie, Dr. K. Lowenfeld.

New General Traction Company, Ltd., 8, Crosby Square, London, E.C. *Managing Director*, E. A. Hopkins; *Secretary*, J. G. Mills; *Chief Engineer*, I. E. Winslow; *Chairman*, Baron E. B. d'Erlanger. [This company controls the Norwich and the Douglas Southern Electric Tramways Companies.]

New St. Helens and District Tramways Company, Ltd., Atherton, Lancs. [T.A., Tramways, Atherton; T.N., 36 Atherton.] *Secretary*, H. P. Conibear; *Chairman*, Hon. Arthur Stanley, M.P.; *Directors*, J. Hunter, J.P., H. Martin, J.P., J. M. Henderson, M.P., J. S. Austen, and E. H. Edwardes (*Managing*).

North Shields Tramway Company owned and worked by Tynemouth and District Elec. Trac. Co. *q.v.*

Norwich Electric Tramway Company, 5, Orford Hill, Norwich, and 8, Crosby Square, London, E.C. [T.A., Tramways, Norwich; T.N., 475.] *Manager and Engineer*, F. W. Ketley; *Consulting Eng.*, I. E. Winslow; *Sec.*, J. G. Mills; *Chairman*, Baron E. B. d'Erlanger; *Directors*, E. A. Hopkins, Hon. A. G. Brand, F. FitzGerald, G. M. Chamberlin.

Nottinghamshire and Derbyshire Tramways Company, Tramway Depot, Langley Mill, Derbyshire, and 66, Queen Street, London, E.C. [T.A., Tramways, Langley Mill; T.N., 53, Langley Mill.] *Manager*, Stanley Dudman; *Secretary*, Wm. C. Bryden; *Directors*, A. R. Holland, A. H. Beatty, A. V. Anderson, and M. A. Edwards.

Oldham, Ashton and Hyde Electric Tramway, Ltd., Tramway Depot, Denton, Lancs., and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Denton; T.N., 265 Ashton.] *Supt.*, A. Anderson; *Secretary*, W. E. Woodroofe; *Chairman*, E. Garcke; *Directors*, L. A. Atherley Jones, K.C., R. Whittaker, W. S. Wreathall, J. V. Kitchener (*Managing Director.*)

Paisley District Tramways Company, Tramway Depôt, Paisley, and 83, Cannon Street, London, E.C. [T.N., 218 Paisley.] *Gen. Manager and Elec. Eng.*, Fred Coutts; *Traffic Supt.*, E. Jeffs; *Secretary*, A. Clements; *Con. Eng.*, H. F. Parshall; *Chairman*, O. H. Smith; *Directors*, Lord Arthur Butler, D. Johnston Smith, John Young.

Peterborough Electric Traction Company, Ltd., Lincoln Road, Peterborough, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Peterborough; T.N., 224.] *Gen. Manager*, T. G. Clabburn; *Secretary*, S. M. Wright; *Chairman*, Lord Vaux of Harrowden; *Director*, E. A. Paris.

Plymouth, Stonehouse and Devonport Tramways Co., 16, Edgcumbe Street, Stonehouse, Devon, and Moorgate Station Chambers, London, E.C. [T.N. 53.] *Manager*, G. H. Moreton; *Elec. Eng.*, J. Graham Pearce; *Sec.*, J. Barber Glenn; *Chairman*, Andrew Beattie, J.P., D.L.; *Directors*, S. Hern, J. B. Glenn (*Managing*).

Portsdown and Horndean Light Railway, Cosham, Hants.; Tramways and Lighting Office, Gosport, Hants., and Moorgate Station Chambers, London, E.C. [T.A., Tramways, Gosport; T.N., Municipal 16 and Nat. 8, Gosport.] *Engineer and Manager*, J. Fereday Glenn; *Secretary*, J. Barber Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Directors*, J. Barber Glenn (*Managing*), S. Hern.

Potteries Electric Traction Company, Tramway Depôt, Stoke-on-Trent, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Stoke-on-Trent; T.N., 801.] *Gen. Manager and Eng.*, W. Thom; *Power and Rolling Stock Supt.*, F. J. Chapple; *Traffic Manager*, F. Hatch; *Secretary*, W. F. Herring; *Chairman*, G. Cornwallis-West; *Directors*, F. W. Chanter, S. Mear, J. V. Kitchener.

Rhondda Tramways Company, Ltd., Tramway Depot, Porth, Rhondda, and Laurence Pountney Hill, Cannon Street, London, E.C. [T.A., Tramway, Porth; T.N., 8.] *Manager and Engineer*, H. Holliday; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Directors*, J. C. Saunders, W. B. Cownie, J. T. Jervis, H. T. Barnett.

Rothesay Tramways Company, Ltd., Point House, Rothesay, and Electrical Federation Offices, Kingsway, London, W.C. *Manager*, A. Robertson; *Elec. Eng.*, H. H. Hill; *Sec.*, W. F. Herring; *Chairman*, A. C. Miles; *Directors*, W. L. Madgen, H. S. Day.

Ryde Pier Company, Ryde, Isle of Wight. *Manager*, W. D. Stanray; *Elec. Eng.*, C. Harrison; *Chairman*, G. E. Mears.

Scarborough Tramways Company, Scalby Road, Scarborough. [T.A., Electric Tramways, Scarborough; T.N., 294.] *Gen. Manager and Elec. Eng.*, J. V. Moinet; *Chairman*, F. E. Gripper; *Directors*, V. Fowler, M. T. Whittaker, J. C. Wigham.

Sheerness and District Electric Power and Traction Company, Ltd., Electricity Works, Sheerness East, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Sheerness; T.N., 45.] *Manager & Eng.*, C. W. Durnford; *Sec.*, P. N. Gray; *Chairman*, G. J. Somerville; *Directors*, R. J. Howley, E. R. Soames.

Snaefell Mountain Railway (See Manx Electric Railway Company).

South Metropolitan Electric Tramways and Lighting Company, Ltd., 114, Church Street, Croydon, 30, High Street, Sutton, and Electric Railway House, Broadway, Westminster, London, S.W. [T.N., 304 Croydon, 14 Sutton and 6800, Victoria.] *Gen. Manager and Engineer*, A. V. Mason; *Supt.*, A. E. Wray; *Secretary*, S. J. Clements; *Chairman*, C. G. Tegetmeier; *Directors*, J. Devonshire, E. Garcke.

Southport Pier Co., Ltd., Southport. [T.A., Pier, Southport; T.N., 174.] *Manager*, W. H. Scott; *Chairman*, A. Skinner; *Directors*, I. R. Haworth, S. J. Fane, G. Duckworth, J. Duckworth.

Southport Tramways Company, Ltd., The Depôt, Churchtown, Southport, and Electrical Federation Offices, Kingsway, London, W.C. *Manager*, J. Lloyd; *Secretary*, H. A. Stagg; *Chairman*, C. S. Hilton; *Directors*, J. S. Raworth, Lord Vaux of Harrowden, J. V. Kitchener.

South Staffordshire Tramways (Lessee) Company, Ltd., Power Station, Downing Street, Smethwick, and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 65 Smethwick.] *General Manager*, W. G. Bond; *Secretary*, E. H. Woodhall; *Chairman*, W. S. Schuster; *Directors*, J. A. Lycett, S. R. Blundstone, W. G. Bond, B. Kingsford.

Sunderland District Electric Tramways. Ltd., Fence Houses, co. Durham. [T.A., Trams, Philadelphia, Shiney Row; T.N., 21, Houghton-le-Spring.] *Resident Manager and Engineer*, G. Stratton; *Traffic Manager*, E. A. Pearman; *Secretary*, H. J. Almond; *Directors*, H. R. Hogg, Hon. R. Parker, R. Tayler.

Sutton and Howth Electric Tramway Company (owned by the Great Northern Railway, Ireland), Sutton, county Dublin, and Amiens Street Terminus, Dublin. [T.A., Railroad, Dublin; T.N., 171, Dublin. and 16 Sutton.] *Gen. Manager*, John Bagwell; *Elec. Eng.*, A. W. Whieldon; *Supt. of Line*, R. J. Moore; *Chief Eng.* F. A. Campion; *Locomotive Supt.*, G. T. Glover; *Sec.*, T. Morrison; *Chairman*, F. Vernon; *Directors*, W. P. Cairnes (*Deputy Chairman*), Sir W. Q. Ewart, Bart., W. B. Carson, H. S. Guinness, J. T. Reade, W. L. A. Goulding, Major J. C. W. Madden, R. A. Gradwell, J. Milne Barbour, T. F. Cooke, W. H. B. Moorhead, Lt.-Col. H. Plews.

Swansea Improvements and Tramways Company, 2, Rutland St., Swansea, and Electrical Federation Offices. Kingsway, London, W.C. [T.A., Tramway, Swansea; T.N., 268 Swansea.] *Gen. Manager*, D. James; *Elec. Eng.*, A. Johnston; *Secretary*, S. J. Clements; *Chairman*, C. G. Tegetmeier; *Directors*, G. J. Somerville, S. E. Garcke.

Taunton Electric Traction Company, Ltd., East Reach, Taunton, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Taunton, c/o "Tramways," London.] *Manager*, B. H. Griffith; *Secretary*, S. M. Wright; *Chairman*, G. J. Somerville; *Directors*, E. Garcke.

Torquay Tramways Co., Ltd., St. Marychurch Road, Torquay. [T.A., Carsheds, Torquay; T.N., 167 Torquay.] *Registered Office*, 3, Laurence Pountney Hill, Cannon Street, E.C. *Manager and Eng.*, H. J. Nisbett; *Secretary*, L. D. H. Jacobs; *Managing Director*, W. B. Cownie.

Trafford Park Company (Tramways), Trafford Park, Manchester. [T.A., Developing, Manchester; T.N., 61, Trafford Park.] *Secretary*, C. A. Grundy; *Chairman*, Marshall Stevens; *Directors*, Sir J. Lyons, H. McNiel.

[Lines worked by the Manchester and Salford Corporations.]

Tynemouth and District Electric Traction Company, Limited, John Street, Cullercoats, Northumberland, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tram Co., Cullercoats; T.N., 17 Whitley.] *Gen. Manager*, R. Simpson; *Sec.*, C. W. Francis; *Chairman*, H. S. Day; *Directors*, J. H. Robinson, J. B. Williamson, R. J. Howley Geo. J. Somerville.

Tyneside Tramways and Tramroad Company, Ltd., Neptune Bank, Wallsend. [T.A., Tramways, Wallsend; T.N., 84.] *Secretary & Res. Manager*, J. C. Little; *Elec. Eng.*, F. H. Briggs; *Cons. Eng.*, W. McLellan; *Chairman*, J. T. Merz; *Directors*, Lord Armstrong, J. H. Armstrong, G. E. Henderson, S. Hunter.

Wakefield and District Light Railway Company, Belle Isle, Wakefield.

[This company has been amalgamated with the Yorkshire (West Riding) Electric Tramways Co., Ltd.]

Walton-on-the-Naze Pier Tramway (Coast Development Corporation, Ltd.), The Pier, Walton-on-the-Naze. [T.A., Electricity Works, Walton-on-Naze.] *Eng.*, E. A. Lambert, A.M.I.E.E.; *Sec.*, J. F. Stovell; *Chairman*, — Hallett; *Directors*, Sir T. Sturmey Cave P. Denny, G. Mitchell, G. Riley, H. R. Spence (*Managing*).

Wemyss and District Tramways Company, Ltd., Car Depot, Aberhill, Methill, N.B. [T.A., Tramways, Methill; T.N., 88 Leven.] *Gen. Manager*, W. T. Dawson; *Sec.*, J. O. Shepherd; *Chairman*, G. Balfour; *Directors*, W. Shepherd, G. Balfour, J. H. Guild.

Weston-super-Mare and District Electric Supply Co., Ltd., Locking Road, Weston-super-Mare, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Weston-s.-Mare; T.N., 79 & 181.] *Manager and Elec. Eng.*, G. Charlton; *Sec.*, H. A. Stagg; *Chairman*, G. J. Somerville; *Directors*, C. G. Tegetmeier, E. R. Soames.

Wolverhampton District Electric Tramways, Limited, Power Station, Downing Street, Smethwick, and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 65 Smethwick.] *General Manager*, W. G. Bond; *Sec.*, C. H. Woodhall; *Chairman*, S. R. Blundstone; *Directors*, J. A. Lycett, W. G. Bond, B. Kingsford.

Worcester Electric Traction Company, Ltd., St. John's, Worcester, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Worcester; T.N., 81.] *Manager*, J. R. Groves; *Secretary*, C. W. Francis; *Chairman*, H. S. Day; *Directors*, J. A. Lycett, C. S. B. Hilton, S. E. Garcke.

Wrexham and District Electric Tramways Limited, 6, Lord Street, Wrexham, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Wrexham; T.N., 182, Wrexham.] *Manager*, A. A. Hawkins; *Sec.*, W. E. Bennett; *Chairman*, J. V. Kitchener; *Directors*, G. J. Somerville, W. S. Wreathall.

Yorkshire (West Riding) Electric Tramways Co., Ltd., Belle Isle, Wakefield. [T.A., England, Belle Isle, Wakefield; T.N., 213.] *Gen. Manager and Sec.*, H. England; *Elec. Engs.*, C. J. Jewell and E. A. Wood; *Traffic Supt.*, W. Wilde; *Chairman*, Sir Herbert S. Leon, Bart.; *Directors*, E. Schenk, B. Newgass, G. E. Leon.

Yorkshire (Woollen District) Electric Tramways, Limited, Frost Hill, Liversedge, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Heckmondwike; T.N., 8 Heckmondwike.] *Secretary*, P. N. Gray; *Chairman*, E. Garcke; *Directors*, Sir Thos. Pilkington, E. A. Paris (*managing*).

TRAMWAY ASSOCIATIONS.

MUNICIPAL TRAMWAYS ASSOCIATION.

President:
Alderman H. Linsley
(chairman, Salford Corporation Tramways Committee).

Vice-President:
Peter Fisher
(general manager, Dundee Corporation Tramways).

Hon. Secretary and Treasurer:
C. J. Spencer
(general manager, Bradford Corporation Tramways), 7, Hall Ings, Bradford.

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

President:
The Rt. Hon. Viscount Chilston.

Chairman:
The Hon. Arthur Stanley, M.P.

Vice-Chairman:
Harry England.

Hon. Solicitor: W. Morris, Junr. — *Hon. Auditor:* A. W. Chambers, A.S.A.A.

Secretary:
A. de Turckheim.

Offices: Caxton House, Westminster, London, S.W. Telephone No. 2110 Victoria.

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LIST OF ELECTRIC TRAMWAYS & RAILWAYS.

PARTICULARS OF TRACK AND EQUIPMENT.

TRAMWAYS, pp. xxvii-xxx. RAILWAYS, p. xxx.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No of Motor Cars.	No of Dynamos	No. of Engines	Type of Engines	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment
TRAMWAYS.				ft. in.	lbs.	1 in	ft. rad						
Aberdare Urban District Trys. ..	Oct., 1913	2·9	3·3	3 6	96 G	13	45	10	2	2	V. Cp. C.	400	Lanc. Dynamo Co.
Aberdeen Corporation	Dec., 1899	14·4	27·75	4 8½	96 G	13	42·5	77	*14	14	V. Cp. C.	4,610	Macartney, McElroy & Co.
Aberdeen Suburban Trys. Co. ..	June, 1905	5	5	4 8½	95 G	28	90	9	..	..	..	..	J. G. White & Co Brush Co.
Accrington Corporation	Aug., 1907	7	10·66	4 0	95 G	14	..	27	*8	8	..	1,888	Brush Co.
Airdrie & Coatbridge Tramway Co.	Feb., 1904	3·63	4·94	4 8½	94 G	14	210	15	..	..	..	..	Brush Co.
Ashton-under-Lyne Corporation	Aug., 1902	7	8·15	4 8½	96 G	10	40	21	5	5	..	400	Dick, Kerr, & Co Siemens Bros.
Ayr Corporation	Sept., 1901	6	7·612	4 8½	90 G	21	45	20	*8	8	..	400	British T-H.
Barking Town Urban District ..	Dec., 1903	2·6	3·125	4 8½	100 G	25	44	9	4	3	V. Cp. C.	..	Blackwell & Co
Barnsley & Dist. Elec. Traction Co.	Nov., 1902	3·06	4·25	4 8½	97 G	10	60	13	*6	6	..	..	J. G. White & Co Brush Co.
Barrow-in-Furness	Feb., 1904	5·37	8·25	4 0	90 G	13	50	16	*8	..	..	..	Brush Co. Dick, Kerr, & Co.
Bath Electric Tramways, Ltd. ..	Jan., 1904	14·7	19·3	4 8½	95 G	10·7	38	40	4	4	H.T. Cp.	675	Westinghouse
Batley Corporation	Oct., 1903	6·536	10·47	4 8½	104 G	9	40	15	4	4	..	..	B. I. W. Co. British Elc. Cr. Co
Belfast City	Dec., 1905	49·65	98·54	4 8½	105 G	15	35	282	3	3	Tri. Exp.	3,000	J. G. White & Co. Westinghouse
Bessbrook—Newry (1) .. .. Bessbrook and Newry Try. Co.	Oct., 1885	3	3	3 0	41 V	80	55	2	2	1	Hyd. Turb	..	Mather & Platt
Bexley Urban District	Oct., 1903	5·25	6·5	4 8½	90 G	14	40	16	2	2	V. Cp.	..	Dick, Kerr, & Co.
Birkenhead Corporation	Feb., 1901	13·8	24·09	4 8½	100 G	13½	40	59	6	6	V. Cp.	..	Blackwell & Co British T-H.
Birmingham Corporation	Jan., 1904	65·56	114·55	3 6	105 G	13	40	511	..	..	..	1,475	Dick, Kerr, & Co.
Birmingham and Midland Trys. Co.	July, 1904	12·20	18·8	3 6	85 & 94 G	15	31	62	6	6	Cp.	..	Brush Co.
Blackburn Corporation	March, 1899	14·67	24·75	4 0	92 G	15	30	61	*4	4	V. Cp. C.	..	British T-H. Blackwell & Co.
Blackpool Corporation	Oct., 1885	14·75	21·38	4 8½	96 G	20	36	72	..	..	Stm. Turb	600	Elwell-Parker British T-H.
Blackpool & Fleetwood Tramrd. Co.	July, 1898	7·9	15	4 8½	56 & 70 V / 98 G	26	80	37	5	5	V. Cp.	600	Mather & Platt Dick, Kerr, & Co
Blackpool and Fylde Light Ry. Co.	Under cons.	14	14·5	4 8½	..	..	..	..	..	..	..	..	
Blackpool—St. Anne's & Lytham ..	May, 1903	7·47	14·03	4 8½	92 G	22	35	40	..	..	..	..	British T-H.
Bolton Corporation	Nov., 1899	26	47·21	4 8½	90G	14	35	106	*12	12	V. Cp. C.	3,800	Dick, Kerr, & Co. Blackwell & Co.
Bootle Corporation	May, 1900	4·125	7·75	4 8½	95 G	20	40	55	8	8	..	..	Blackwell & Co.
Bournemouth Corporation	July, 1902	22	29·77	3 6	100 G / 66 slot	10	40	81	4	4	Cp.	1,500	J. G. White & Co.
Bradford Corporation	July, 1898	54·8	103·86	4 0	102 G	9·8	40	242	11	11	V. Cp. C.	..	Westinghouse Blackwell & Co.
Bray and Enniskerry Railway Co.	Under cons.	3·25	5	3 6	..	..	..	..	..	..	..	..	
Brighton Corporation	Nov., 1901	9·48	17·18	3 6	101 G	9	40	50	5	5	Stm. Turb.	1,000	Macartney & Co. Westinghouse Blackwell & Co.
Brighton Beach (1)	Aug., 1883	1·75	2	2 8½	35 V	100	80	8	2	1	Gas	..	Siemens Bros.
Bristol—Bristol Trys. Co.	Oct., 1895	31	57·5	4 8½	92½ G	10	30	232	6	4	V. Cp. C.	..	British T-H. and Blackwell & Co.
Burnley Corporation	Dec., 1901	11·9	22·16	4 0	102 & 107 G	9·8	35	57	*8	8	H. Cp. C.	750	British T-H.
Burton and Ashby Light Railway..	July, 1906	10·2	12·3	3 6	90 G	11	51	20	2	2	Diesel	330	Dick, Kerr & Co. Brush Co.
Burton-on-Trent Corporation ..	Aug., 1903	6·67	9·75	3 6	90 G	11·7	40	20	4	3	V. Cp.	400	Dick, Kerr, & Co. Blackwell & Co.
Bury Corporation	June, 1903	22·5	34·42	4 8½	102¾ G	12	40	54	6	6	..	1,500	Westinghouse
Camborne and Redruth	Nov., 1902	3·75	4	3 6	83 G	15	40	8	7	7	Cp.	1,525	Dick, Kerr, & Co. British T-H.
Cardiff Corporation	May, 1902	17·25	31·82	4 8½	100 G	23	35	130	9	9	V. Cp. C.	2,200	British T-H. Dick, Kerr, & Co.
Carlisle, City of, Elec. Try. Co. ..	June, 1900	7·25	8·5	3 6	83 G	14	23	15	4	4	..	..	Dick, Kerr, & Co.
Cavehill & Whitewell Try. Co...	Feb., 1906	3·29	4·31	4 9	105 G	31	75	10	..	..	..	..	J. G. White & Co.
Chatham & District Light Rly. Co.	June, 1902	14·98	26	3 6	92½ & 105 G	9	35	47	5	4	H. Cp.	675	British T-H. Co. Brush Co.
Cheltenham and District ..	Aug., 1901	10·22	12·25	3 6	80 & 90 G	8·9	37	20	2	2	V. Cp.	..	Westinghouse
Chester Corporation..	April, 1903	3·51	6·3	3 6	94 & 100 G	30	40	18	*7	7	V. Cp. C.	240	Blackwell & Co. British T-H.
Chesterfield Corporation	Dec., 1904	3·6	5·1	4 8½	96 & 101 G	20	40	14	4	4	V. Cp. C.	800	Milnes & Co. Westinghouse Brush
Clontarf and Hill of Howth ..	July, 1900	5·5	6·5	5 3	90 & 60 G	13	34	12	..	..	..	..	W. M. Murphy & Co.
Colchester Corporation	July, 1904	6	7·94	3 6	95 G	12	43	18	8	8	V. Cp.	1,140	Dick, Kerr & Co J. G. White & Co.
Colne Corporation Tramways ..	Nov., 1903	5·2	6·7	4 0	102 G	13	60	12	*	..	..	..	Blackwell & Co. Glover & Co.
Cork Elec. Try. & Lighting Co. ..	Dec., 1898	10	15	2 11½	83 G	14	26	35	*9	9	H. Cp. C.	1,450	British T-H. Blackwell & Co.
Coventry Corporation Tramways..	Dec., 1895	13·25	15·40	3 6	65 G / 81 G	16	35	41	5	5	H. & V. Cp.	700	Westinghouse Blackwell & Co.
Croydon Corporation	Sept., 1901	11	19·12	4 8½	96·5 G	16	40	75	*13	13	..	2,000	British T-H. Co.
Darlington Corporation	June, 1904	4·875	8·88	3 6	90 G	14	46	16	9	7	..	..	Westinghouse

* Current from combined lighting and traction station. (1) Third rail system. † Includes 1·25 miles railless trolley line.

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ELECTRIC TRAMWAYS & RAILWAYS.—Particulars of Track and Equipment.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total Length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars	No. of Dynamos	No. of Engines	Type of Engines.	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment.
TRAMWAYS—*continued.*				ft. in.	lbs.	1 in	ft. rad.						
Dartford U. D. C.	Feb., 1906	6·5	8·5	4 8½	100 G	12	35	12	4	..	..	..	British I. W.
Darwen Corporation	Oct., 1900	4·36	7·16	4 0	95 G	9	35	17	*4	4	H. Cp.	..	British T-H.
Derby and Ashbourne	..	14·5	..	4 8½									
Derby Corporation	July, 1904	13	22·06	4 0	95 G	14	46	50	3	3	Stm.Turb.	..	J. G. White & Co. Brush Co.
Devonport & District Try. Co., Ltd.	June, 1901	8·85	15·79	3 6	92 G	11	35	25	*	..	..	..	Blackwell & Co
Devonport Corporation	June, 1901	..	7	3 6	97 G	10	50	12	..	..	..	..	Blackwell & Co.
Doncaster Corporation	June, 1902	8·25	12·52	4 8½	94 G	16	45	25	8	8	..	1,000	Blackwell & Co.
Dover Corporation	Sept., 1897	4·75	7	3 6	87 & 90 G	10	44	21	*2	2	H.CC.	..	Dick, Kerr, & Co.
Douglas—Port Soderick .. Douglas Southern Elec. Trys. Co.	Aug., 1896	3·25	3·75	4 8½	65 V	12	45	8	2	2	H. Cp.	200	Westinghouse British T-H.
Dublin & Lucan Elec. Railway Co.	March, 1900	6·5	7	3 6	50 V	20	27	16	2	2	H.Cp.C.	240	Dick, Kerr, & Co
Dublin United Tramways Co.	May, 1896	49·8	95·26	5 3	105 G	12·3	22	365	8	7	V.Cp.C.	4,300	Dick, Kerr, & Co Blackwell & Co. British T-H.
Dudley and Stourbridge Trys. British Electric Traction Co.	July, 1899	21·25	27·25	3 6	90 G	11	50	59	4	4	H. Cp.	..	British T-H. Blackwell & Co.
Dumbarton	Feb., 1907	13	17	4 7¾	90 & 96	14	60	26	3	3	..	..	Dick, Kerr, & Co.
Dundalk	Under cons.	6	6·25	3 6	97 G	10	50	12					J. G. White & Co.
Dundee, Broughty Ferry, and District	Dec., 1905	5	9·125	4 8½	90 G	16·5	30½	14	3	3	V.Cp.C.	..	J. G. White & Co British T-H. Co.
Dundee Corporation	July, 1900	15·5	27·47	4 8½	90 & 100 G	10	35	68	5	5	..	..	Blackwell & Co.
Dunfermline (Fife Try. & Power Co.)	Nov., 1909	14·6	17·4	..	90 G	10	25	28	2	2	..	..	
East Ham Corporation	June, 1901	7·26	14·34	4 8½	90 & 105 G	25	40	45	5	5	H. Cp.	500	Dick, Kerr, & Co.
Eccles Corporation	May, 1902	5	7·75	4 8½	100 G	..	..	..	..	..	..	..	
Edinburgh and District	June, 1910	1·25	1·5	4 8½	100 G	21	54	4	..	..	..	..	Dick, Kerr, & Co.
Erith Urban District Council	Aug., 1905	4·7	8·4	4 8½	100 G	17	40	17	3	5	..	..	Brush Co. WestinghouseCo.
Exeter Corporation	April, 1905	4·875	7	3 6	90 G	11·5	35	20	*4	4	H. Cp.	..	Dick, Kerr, & Co.
Falkirk and District	Oct. 1905	7·81	10·5	4 0	90 G.	11·3	48	18	*	..	..	..	Bruce Peebles &Co.
Farnworth Urban District	Jan., 1902	4·33	7·16	4 8½	98 G	29	36	13	4	4	..	..	
Felixstowe Pier	Aug., 1905	0·5	0·5	3 6	36	..	..	3	..	..	..	..	
Gateshead and District	May, 1901	11·25	17·30	4 8½	90 G	8	35	53	*	..	..	..	Dick, Kerr, & Co. Blackwell & Co.
Giant's Causeway Elec. Try. Co.	Sept., 1883	8	9	3 0	42 V 75 G	24	30	26	2	2	Hyd.Turb.	..	Siemens Bros. British T-H.
Glasgow Corporation	Oct., 1898	98·18	196·23	4 7¾	110 G	11·93	30¾	843	7	7	V. Cp.	14,200	British T-H. Westinghouse
Glossop Urban District	Aug., 1903	4·56	5·6	4 8½	90 G	13	40	8	4	4	V. Cp.	200	British T-H.
Gloucester Corporation Light Rly.	May, 1904	9	15	3 6	90 G	25	40	30	*2	2	Cp.	750	Brush Co. Dick, Kerr, & Co.
Gosport & Fareham Trys. Co.	Jan., 1906	7·5	11·5	4 7¾	96 G	16	37½	22	3	3	V.Cp.C.	750	Dick, Kerr, & Co.
Gravesend and Northfleet	Aug., 1902	6·5	9	4 8½	87 G	11	45	18	*				Brush Co.
Great Crosby	June, 1900	2·5	2·5	4 8½	92½ G	..	40	14	*7	7	H. & V.Cp.	160	Dick, Kerr, & Co. Blackwell & Co.
Great Grimsby	Dec., 1901	6	11	4 8½	90 G	15	26	38	2	2	..	300	Dick, Kerr, & Co.
Greenock and Port Glasgow	Oct., 1901	7·425	14·05	4 7¾	90 G	11	60	42	*				
Guernsey Railway Co.	Nov., 1892	3	3	3 8½	40 & 74 V 84 G	60	60	18	2	2	H. &V. Cp.	160	Siemens Bros. British T-H.
Halifax Corporation	June, 1898	37·4	54·88	3 6	95½ G	9·5	38·6	95	*9	9	H. &V. Cp.	2,500	Electric Cons. Co British T-H.
Hampshire Light Railway (Elec.) Co.	March, 1903	6	9	4 8½	..	..	..	10	*				
Hartlepool Electric Tramways Co.	May, 1896	6·72	8·3	3 6	87 & 90 G	15	35	21	4	4	V. Cp	..	Electric Cons. Co Dick, Kerr, & Co.
Haslingden Corporation	July, 1908	3	3	4 0	100 G	10	30	..	..	..	..	..	Dick, Kerr, & Co.
Hastings and District	July, 1905	19·33	34	3 6	90 G	8	36·75	65	6	6	V. Cp.	2,100	Dick, Kerr, & Co.
Herne Bay Pier (1)	March, 1899	·75	·75	3 0	60	..	..	3	1	1	Gas	50	British T-H.
Heywood Corporation	Dec., 1905	4·25	4·25	4 8½	90 G	17	..	..	3	3	..	..	Blackwell & Co. B.I. & H.C. Co.
Houghton-le-Spring (See Sunderland Dist. Elec. Trys.)													
Huddersfield Corporation	Feb., 1901	31·07	48·5	4 7¾	98 G	11	35	96	4	4	V.Cp.C.	2,200	British T-H.
Hull Corporation	July, 1899	13·46	30·5	4 8½	94 G	20	30	160	7	7	V.Cp.C.	2,500	British T-H. Westinghouse
Ilford Urban District	Mar., 1903	6·5	11 35	4 8½	95 G	13	33·3	26	*7	7	..	1,600	British T-H. Dick, Kerr, & Co.
Ilkeston Corporation	May, 1903	3·8	4·3	3 6	90 G	12	28	13	2	1	..	..	Dick, Kerr, & Co.
Ipswich Corporation	Nov., 1903	10·8	14·87	3 6	90 G	11·5	40	36	10	10	Enclos'd	1,175	Westinghouse
Isle of Man— Manx Elc. Rly. Co. Douglas to Ramsey	July, 1893	18	35·75	3 0	62½ V	24	90	65	9	9	H. Cp.	1 300	Mather & Platt
Manx Elc. Rly. Co. Snaefell Mountain	Aug., 1895	4·5	9·5	3 6	56 V	12	90						
Isle of Thanet Trys. & Ltg. Co.	April, 1901	11	20·67	3 6	90 G	11	38	59	*6	6	3 V. Cp. 3 H. Cp.	800	British T-H. Blackwell & Co.
Jarrow and District	Nov., 1906	2·54	3·42	4 8½	95 G	12·5	50	10	..	..	..	..	Brush Co. B.I. & H.C. Co.
Kearsley Urban District	Jan., 1902	1·75	1·75	4 8½	95 G	20	..	..	..	..	..	..	Westinghouse
Keighley Corporation	Oct., 1904	3·5	6·11	4 0	95 G	25	60	12	*4	4	V.	200	Blackwell & Co. Brush Co.
Kidderminster—Stourport British Electric Traction Co.	May, 1898	4·6	4·87	3 6	75 G	14	45	13	*5	5	Stm Turb.	..	Brush Elc.Eg.Co
Kilmarnock Corporation	Dec., 1904	4·18	5·5	4 8½	90 G	24	45	14	*3	3	..	250	Blackwell & Co.
King's Norton & Northfield U. D.	May, 1904	5·25	8·25	3 6	105 G	15&21	100&145	..	..	..	..	..	Blackwell & Co.
Kinver	April, 1901	4	4	3 6	63 & 90 G	..	..	6					
Kirkcaldy Corporation	Feb., 1903	6·11	8·56	3 6	100 G	11	40	22	*8	6	Cp. H.S.	1,090	British T-H. Co
Lanarkshire Tramway Co.	July, 1903	21·21	34·4	4 7¾	96 & 101 G	9·4	37	60	4	4	3 H. Cp. 1 V. Cp.	825	British T-H. Co.
Lancashire United Tramways Co.	Oct., 1902	39	54	4 8½	90 G	15	50	82	*5	5	V. Cp.C.	2,750	B. I. W. Co.
Lancaster Corporation	Jan., 1903	4	4·81	4 8½	90 G	8	30	12	4	4	V. Cp.	200	Greenwood & Batley, Ltd.
Leamington & Warwick Elec. T. Co.	July, 1905	3·04	6·1	3 6	65 G	12	47	12	3	3	Cp.	..	Brush Co.
Leeds City	Aug., 1897	69·02	114·62	4 8½	105 & 111 G	8·4	32	315	5 3	5 3	H. Cp C. Stm. Tur	6,150	Elec. Con. Co. Greenwood & Batley, British T-H Blackwell & Co.

* Current from combined lighting and traction station. (1) Third Rail system.

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ELECTRIC TRAMWAYS & RAILWAYS.—Particulars of Track and Equipment.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars.	No. of Dynamos	No. of Engines.	Type of Engines.	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment.
TRAMWAYS—*continued.*				ft. in.	lbs.	1 in	ft. rad.						
Leicester Corporation	May, 1904	20	37	4 8½	100 G	16	35	140	4	4	V. Cp.C.	2,500	Dick, Kerr, & Co. / Blackwell & Co
Leith Corporation	Aug., 1905	9·08	17·9	4 8½	106·7 G	19	54	37	*11	11	..	1,600	Brush Co.
Leyton Urban District	Dec., 1906	9·125	18·5	4 8½	105 & 111 G	24	45	60	*8	8	Cp.	1,600	..
Lincoln Corporation (1)	Nov., 1905	1·75	2·96	4 8½	100 G	..	..	8	*8	8	..	645	Blackwell & Co.
Liverpool Corporation	Nov., 1898	63	119	4 8½	95 & 98 G	13	40	587	*55	55	V. Cp. Trip Exp	35,300	British T-H. / Dick, Kerr, & Co. / Westinghouse
Liverpool Overh'd Ry. (Trol. Ln. Ex.)	June, 1900	2·5	2·5	4 8½	92½ G	Nil	40	14	7	7	H. & V. Cp.	160	Dick, Kerr, & Co.
Llandudno and Colwyn Bay ..	Oct., 1907	6·60	7·573	3 6	90 G	11·5	45	18	*	..	..	..	Bruce Peebles & Co.
Llanelly and District	July, 1911	6·25	6·75	4 8½	90 G	..	..	10	*2	2	Trip. Ex.	..	
London County Council (2) ..	May, 1903	142·98	272·5	4 8½	105 G	11	45	1661	8	8	V. Cp. C.	34,000	Dick, Kerr, & Co. / Westinghouse
London United Tramways Co. ..	April, 1901	55·25	102·45	4 8½	92½ & 100 G	18	28	339	7	5	V. Cp.	3,500	British T-H. / Westinghouse. / Blackwell & Co.
Lowestoft Corporation	July, 1903	4·75	5·07	3 6	100 G	27	36	19	*5	5	Cp.	..	Blackwell & Co.
Luton Corporation Tramways .. (Leased to J. G. White & Co., Ltd.)	Feb., 1908	5·25	6·25	4 8½	95 G	11	35	12	*1	1	..	..	J. G. White & Co.
Maidstone Corporation	July, 1904	5·5	7·04	3 6½	96 G	9	35	19	6	6	..	300	Dick, Kerr & Co.
Manchester Corporation	June, 1901	119·76	202·7	4 8½	105 G	14·9	35	662	*22	22	Turb'nes	45,300	British T-H. / Dick, Kerr, & Co
Mansfield and District Co. ..	July, 1905	10	12·25	4 8½	90 G	17	50	20	*3	3	..	..	
Merthyr	April, 1901	2·98	3·94	3 6	96 G	11	66	16	*4	4	H.S.V.	..	Dick, Kerr, & Co
Metropolitan Electric Trys., Ltd.	July, 1904	52·5	105	4 8½	100 G	12	40	312	5	5	1 Stm. Tur	..	British T-H. / Brush Co.
Mexborough & Swinton Trys. Co.	Feb., 1907	7·75	10·75	4 8½	90 G	8·5	55	20	3	3	..	1,300	Brush Co.
Middlesbro', Stockton, & Thornaby Electric Tramways Co.	July, 1898	10·5	15·825	3 6	92½ G	17	35	60	3	4	H. & V. Cp.	900	British T-H / Blackwell & Co.
Middlesex County Council	Aug., 1904	25·5	51	4 8½	..	..	..	..	..	..	..	..	
Middleton Corporation	March, 1902	2·5	5	4 8½	..	..	..	..	..	..	..	..	
Middleton Electric Traction Co. ..	March, 1902	8·5	10·53	4 8½	90 G	15	49½	28	3	3	..	500	Glover & Co.
Musselburgh and District ..	Dec., 1904	6·5	8·125	4 8½	90 G	34	45	16	4	3	..	400	B. T-H. Co., Nat. Elec. Cons. Co.
Nelson Corporation	Feb., 1903	2·74	3·86	4 0	106 G	11	41	11	*4	4	..	400	Blackwell & Co. / British T-H. Co. / Brush Co.
New St. Helens & District Trys. Co.	July, 1899	18	20	4 8½	95 G	13	35	36	*4	4	V. Cp. C.	..	Westinghouse / British T-H.
Newcastle Corporation	Dec., 1901	31·25	61	4 8½	101 G	11	35	192	5	5	V. Cp.	..	Westinghouse / British T-H.
Newport (Mon.) Corporation ..	April, 1903	7·5	14·35	4 8½	98 G	10·5	40	44	5	5	V. Cp.	1,750	Westinghouse
Northampton Corporation	July, 1904	5·5	9·16	3 6	90 & 96 G	18	50	26	3	3	V. C. C.	520	Dick, Kerr, & Co. / Brush Co.
North Shields Tramways Co. ..	March, 1901	..	7·75	3 6	90 G	10	36	22					
North Staff. Trys. (*vide* Potteries)													
Norwich Electric Tramways Co. ..	July, 1900	14·5	19·25	3 6	65½ & 90 G	12·6	38	52	4	4	H. T. Cp	800	Westinghouse / Blackwell & Co.
Nottingham Corporation	Jan., 1901	19·75	37·5	4 8½	107 G	11·5	40	135	3	3	..	..	British T-H. / Dick, Kerr, & Co.
Nottinghamshire & Derbyshire Tramways Co.	Aug., 1913	12·8	16·10	4 8½	G	..	..	24					
Oldham, Ashton & Hyde Trys. Co.	June, 1899	8·888	11·183	4 8½	97 G	11	28	46	*3	3	V. Cp. C.	..	British T-H.
Oldham Corporation	Dec., 1900	23·42	36·5	4 8½	100 & 102 G	10·5	40	92	*4	4	..	2,220	Dick, Kerr, & Co
Paisley & District Tramways Co.	June, 1904	15	25	4 7½	90 G	10	34	58	..	..	..	..	
Perth Corporation	Oct., 1905	4·846	6·75	3 6	90 G	16	25	12	5	5	Cp.	500	Blackwell & Co.
Peterborough Elec. Traction Co. ..	Jan., 1903	5·33	6·71	3 6	94 G	31	35	14	..	..	..	..	Blackwell & Co. / Dick, Kerr & Co
Plymouth Corporation	Sept., 1899	7·75	15	3 6	92 G	9	35	42	3	3	V. Cp.	..	Elec. Cons. Co. / Westinghouse
Plymouth, Stonehouse, and Devonport	Nov., 1901	1·5	3·62	3 6	84 G	11	34	14	..	..	..	..	Blackwell & Co. / Dick, Kerr, & Co
Pontypridd Urban District ..	March, 1905	5·5	8·6	3 6	96 & 100 G	10	27·6	26	4	4	V. C. Cp.	450	B. I. W. Co. / Blackwell & Co.
Portmadoc & South Snowdon Rly.	Under cons.	13·25	15	1 11½	41	28	200	6	..	..	..	..	
Portsdown & Horndean Tramway	March, 1903	6	7·5	4 7½	96 G	16	40	16	2	2	Oil	200	Dick, Kerr, & Co. / Brush Co.
Portsmouth Corporation	Sept., 1901	15·75	30·83	4 7½	96 & 100 G	17	35	100	5	4	V. & H. Cp.	2,075	Macartney & Co. / Dick, Kerr, & Co.
Potteries Electric Traction Co. ..	May, 1899	31·67	41·48	4 0	87, 90, 100, & 110 G	11	45	110	8	8	H. Cp. / V. Cp.	2,275	Dick, Kerr, & Co. / Blackwell & Co.
Preston Corporation	June, 1904	10·54	17·2	4 8½	95 G	16	28	33	2	2	H. Cp.	600	Dick, Kerr, & Co.
Radcliffe Urban District ..	April, 1905	5	6·5	4 8½	100 G	15	40	..	3	2	V. Cp.	..	Mather & Platt
Rawtenstall Corporation	May, 1909	12	15·9	4 0	100 G	15	38	24	*3	3	..	850	Westinghouse
Reading Corporation	July, 1903	7·44	13·175	4 0	96 G	16	35	36	4	4	V. Cp.	400	Blackwell & Co. / Dick, Kerr, & Co. / Westinghouse
Rhondda Tramways Co.	July, 1908	17·5	24·5	3 6	95 G	15	45	50	8	4	..	1,400	British T-H. / Brush
Rochdale Corporation	May, 1902	19·58 (A)	22·74 (A)	4 8½	103½ G	11·7	30	69	..	..	..	..	British T-H. / Dick, Kerr, & Co. / Brush Co.
Rotherham Corporation	Jan., 1903	10	12	4 8½	100 G	9·5	45	36	*6	6	H. S. Cp.	1,485	Dick, Kerr, & Co.
Rothesay	June, 1902	4·81	9·68	3 6	94 G / 77 G	24	34	20	3	3	V. & Oil	350	Dick, Kerr, & Co.
Ryde Pier, Isle of Wight Ryde Pier Co. (3) ..	March, 1886	·5	1	4 8½	30 & 34 V	..	..	4	2	2	Gas	..	Westinghouse / Siemens Bros.
Salford Corporation	Oct., 1901	41·25	75·79	4 8½	103 G	20	47	200	*8	9	V. Cp. C	2,400	Westinghouse / Mather & Platt
Scarborough Tramways Co. ..	May 1904	5	7·75	3 6	90 G	10·5	35	22	2	2	Stm. Turl	..	Brush Elec. Co.
Sheerness and District	April, 1903	2·5	2·704	3 6	94 G	43	40	8	6	5	V. Cp. C	100	Siemens & Halske / Brush Co.
Sheffield Corporation	Sept., 1899	40	77·84	4 8½	110 & 116 G	9·5	35	279	7	7	1 H. Cp. / 6 V. Cp.	5,725	British T-H.

* Current from combined lighting and traction station. (1) G.B. surface contact system. (2) Mainly Conduit system, but there are now several Trolley lines. Besides the electric lines the London County Council has also 4·45 route miles of horse tramways. (3) Third rail system. (A) Not including 17·1 miles track leased.

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ELECTRIC TRAMWAYS (contd.).	Date of Opening of First Section.	Length of Route.	Total Length of Track.	Gauge.	Weight and Type of Rail	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars.	No. of Dynamos	No. of Engines.	Type of Engines.	Total Capacity Traction, KW.	Principal Contractors for Electrical Equipment.
				ft. in.	lbs.	1 in	ft. rad.						
Shipley Urban District	May, 1902	6	10	4 0	98 G	15	..	..	4	3	..	..	British T-H.
Soothill Nether U.D.C. & Dewsbury & Ossett Corporations ..	Nov., 1908	3·125	4·45	4 8½	90 G	13	50	8	*	..	..	..	Nat. Elec. Cons. Co.
Southampton Corporation	Jan., 1899	10·25	18·5	4 8½	96 G	13	45	70	6	6	H. Cp. C.	1,000	Westinghouse
Southend Corporation	July, 1901	7·01	10·24	3 6	90 G	18	48	31	*6	6	V. Cp. Con.	2,075	British T-H.
Southend Pier (1) Southend Corp.	Aug., 1890	1·25	1·25	3 6	60 G	Lev.	..	25	..	..	..	..	British T-H.
South Metropolitan Elec. Try. Co.	Feb., 1906	13·09	26	4 8½	95 G	16	42	51	*8	6	Stm. Tbs	1,650	Dick, Kerr & Co. / Brush Co.
Southport Corporation (5)	July, 1900	13·5	10·75	4 8½	87 & 90 G	25	45	26	*3	3	H. Cp.	600	Dick, Kerr, & Co.
Southport Electric Tramway Co...	July, 1901	8·17	12·52	4 8½	87 G	Nil	40	21	*				
Southport Pier	1905	1	1	4 0	.. ..	..	..	3	..	..	..	..	Westinghouse
South Shields Corporation ..	March, 1906	5·7	10·25	4 8½	95 G	15	35	35	2	2	V. Cp. C.	1,100	Dick, Kerr & Co.
South Staffordshire	Jan., 1893	18·98	29·5	3 6	97 & 90 G	17	46	46	3	3	C.H. Cp.	..	Blackwell & Co. / E. C. C.
Stalybridge, Hyde, Mossley, and Dukinfield	May, 1904	23·75	27·75	4 8½	99 G	9	27½	60	9	3 / 2	Marine Stm. tur.	7,900	Dick, Kerr, & Co.
Stockport Corporation	Aug., 1901	16	27·62	4 8½	96 G	10·8	35	50	*5	5	Cp.	1,000	Macartney & Co. / Dick, Kerr, & Co.
Sunderland Corporation	Aug., 1900	10·92	20·35	4 8½	96 G	12	36	70	*4	4	..	936	Dick, Kerr, & Co.
Sunderland District Electric Trys.	June, 1905	14·27	15·97	4 8½	90 G	11	40	33	*				
Sutton & Howth (G.N.R., Ireland)	June, 1901	5·3	6	5 3	72 B	16·7	300	11	3	3	V. Cp.	500	British T-H. / Westinghouse
Swansea Tramways Company ..	June, 1900	12·43	18·54	4 8½	84 & 86 G	14	45	65	3	3	H. Cp. C.	620	British T-H.
Swindon Corporation	Sept., 1904	3·7	4·4	3 6	105 G	15	37	12	5	4	..	600	Dick, Kerr & Co.
Taunton Electric Traction Co.	Aug., 1901	1·66	2	3 6	90 G	25	35	6	*	..	..	..	Blackwell & Co.
Torquay Tramways	April, 1907	6·95	11·125	3 6	90 G	12	45	18	*2	1	..	..	
Trafford Park Estates, Ltd. (Trys.)	July, 1903	2·5	2·75	4 8½	100 G	Nil	35	7	4	4	Tand Cp.	..	Westinghouse
Tynemouth and District	March, 1901	4·21	7·83	3 6	90 G	10	30	21	*3	3	..	..	Blackwell & Co.
Tyneside Tramways & Tramroads Co.	Sept., 1902	10·97	16·23	4 8½	95 G	10	40	24	*				
Wakefield & District Lgt. Rlys. Co.	Aug., 1904	24·69	40·382	4 8½	96 G	15·5	40	69	5	5	..	1,200	Dick, Kerr, & Co.
Wallasey Corporation	March, 1902	8·75	19·86	4 8½	98 G	14	40	61	*3	3	V. Cp. C.	1,100	Lanc. Dynamo Co, / Blackwell & Co.
Walsall Corporation	Jan., 1904	13·5	19·5	3 6	90 & 92 G	18·5	32	39	*8	8	V. Cp. C.	1,730	British T-H. / Electric Cons. Co.
Walthamstow U.D.C. Light Rly...	June, 1905	9·14	12·53	4 8½	100 G	18	40	38	*15	15	Gas	1,560	Westinghouse
Walton-on-Naze Pier	Aug., 1898	·5	·5	3 6	36 V	..	..	3	3	2	..	100	
Warrington Corporation	April, 1902	6·5	9·6	4 8½	90 G	27	50	21	*6	6	V.C.	500	Blackwell & Co. / British T-H.
Wemyss and District	Aug., 1906	7·5	9	3 6	95 & 97 G	18	85	17	3	3	2 V. Cp.	..	Bruce Peebles & Co / Brush Co.
West Bromwich Corporation ..	Dec., 1902	7	12·5	3 6	98 G	20	49	29	8	8	Turb'nes	750	Dick, Kerr, & Co. / B. I. W. Co.
West Ham Corporation	Feb., 1904	15·5	30·05	4 8½	100 G	18	40	118	*3	3	V.C. Cp.	1,500	Brush Co.
Weston-super-Mare	May, 1902	2·39	3·5	4 8½	90 G	25	40	12	5	4	Cp.	..	Blackwell & Co. / British T-H. / Brush Co.
Wigan Corporation	Jan., 1901	30·9	45·42	3 6 / 4 8½	105 G	12	45	67	*8	8	..	740	Blackwell & Co.
Wolverhampton Corporation (3) ..	April, 1902	13·5	21·5	3 6	91 G	15	37·5	49	*10	10	H. & V.C. & Turb's	2,900	British T-H. / Electric Cons. Co.
Wolverhampton District	April, 1900	14·75	19	3 6	90 G	20	40	30	*4	..	..	..	B.I.W. & B.T-H. / Westinghouse
Worcester Electric Traction Co. ..	Feb., 1904	5·86	8·58	3 6	94 G	13	45	15	*3	3	..	..	Brush Co. / Dick, Kerr, & Co.
Wrexham and District	April, 1903	4·44	6·16	3 6	96 G	9·11	50	10	*6	..	..	..	British T-H. / Brush Co.
Yarmouth Corporation	June, 1902	10	14·4	3 6	90 & 95 G	27	48	35	3	3	Comp.	..	Brush Co. / B.I.W. Co.
York Corporation	Jan., 1910	6	9·9	3 6	100	18	40	18	*8	8	V.C.	..	Dick, Kerr, & Co. / Brush Co.
Yorkshire Woollen District ..	Feb., 1903	22·25	36	4 8½	94 & 100 G	8	30	69	*	..	..	..	Brush Co. / Dick, Kerr, & Co.
RAILWAYS.													
LONDON AND VICINITY:													
Central London Rly. Co. (1) ..	July, 1900	6·5	13	4 8½	100 V	30	..	68 M. 172 T.	6	6	H. Cp. C.	..	British T-H
City & South London Rly. Co. (1)	Dec., 1890	7·25	14·75	4 8½	60 V / 80 V	30	120	52 L. 142 T	7	7	2 H.C. / 4 V.C.	..	Mather & Platt / Elec. Cons. Co / British T-H.
East London Railway (2) ..	April, 1913	5·75	11·5	4 8½	90 B	..	..	(c)	..	..	..	..	
Gt. Northern & City Rly. Co. (2)	Feb., 1904	3·5	7·75	4 8½	85 V	52	660	35 M 45 T	6	8	V. Cp. C.	..	British T-H.
Great Western Railway .. (Hammersmith and City line.)	Nov., 1906	4·9	10·5	4 8½	97½ B	60	400	48 M. 80 T	10	10	V. Cp.	..	British T-H. / Elec. Con. Co.
London & North Western Rly. (Euston-Watford line) (2)	Under cons.	41·5	80	4 8½	..	..	..	..	..	..	Turbine	..	Siemens Works / Westinghouse
London & South Western Rly. (Kingston Loop, etc.) (2)	Under cons.	24	73	4 8½	..	..	..	..	..	..	Turbine	..	Dick, Kerr & Co. / Westinghouse
London, Brighton, and South Coast Railway (4) .. .. (Extensions in progress)	Dec., 1909	22	70	4 8½	..	..	..	16 M. 8 T.	(d)	..	..	..	Allgemeine El. Ges / British T-H. / Blackwell & Co.
London Electric Railway Co.: Baker St. & Waterloo Ry. (2)	March, 1906	5·5	11·0	4 8½	90 B	60	330	86 M. 72 T.	(a)	..	..	..	Westinghouse / British T-H.
Charing Cross—Hampstead Railway (2)	June, 1907	8	16·5	4 8½	90 B	33	330	60 M. 90 T.	(a)	..	..	..	Westinghouse / British T-H.
Great Northern, Piccadilly & Brompton Rly. (2)	Dec., 1906	9·25	18·5	4 8½	90 B	33	330	72 M. 144 T.	(a)	..	..	..	Westinghouse / British T-H.
Metropolitan Railway (2) ..	Jan., 1905	26	59	4 8½	86 B	44	363	86 M. 172 T	4	4	Turbine	..	Westinghouse / British T-H.
Metropolitan District Railway (and running powers) (2)	July, 1905	41	80·46	4 8½	86 B	40	330	234 M. 286 T.	(a)	..	Turbine	..	British T-H. / Westinghouse
Waterloo and City Rly. Co. (1)	Aug., 1898	7·0	15	4 8½	87 B	30	321	17 M. 12 T.	6	6	V. C.	..	Siemens Bros. / Dick, Kerr & Co.
PROVINCES:													
Lancashire and Yorkshire (2) .. (Extensions in progress)	March, 1904	31	65	4 8½	86 B	85	840	38 M 52 T.	6	5	1 V.C. / 4 H.C.	..	Dick, Kerr, & Co.
Liverpool Overhead Rly. Co. (1)	March, 1893	6·5	13·05	4 8½	60 V	40	429	46 M 7 T	7	7	H.Cp. / V.Cp.	..	Electric Cons. Co. / Dick, Kerr, & Co.
Mersey Railway (1)	April, 1903	4·5	9	4 8½	86 B	27	528	24 M. 37 T.	5	5	V.Cp.	..	Westinghouse / Elec. & Mfg. Co
Midland Rly.—Morecambe and Heysham Branch (4)	June, 1908	9·75	19·5	4 8½	..	..	..	3 M. 6 T.	4	4	Gas.	..	Westinghouse / Siemens Bros.
North Eastern Railway (1) ..	March, 1904	35	80	4 8½	90 B	55	792	60 M. 50 T.	(b)	..	..	..	British T-H. Co.

* Power from combined lighting and power station. (1) Third rail system. (2) Third and fourth rails system. (3) Loram surface contact system. (4) Single phase.
(5) Not including 9 miles owned but leased. Electric Supply Company, Limited.
(a) Power supplied by Chelsea Power Station (80,000 H.P.) (b) Power purchased from the Newcastle-upon-Tyne Electric Supply Corporation.
(c) Rolling stock supplied by Metropolitan Railway. (d) Power supplied by London Electric Supply Corporation.
M—Motor Cars. T—Trail Cars.

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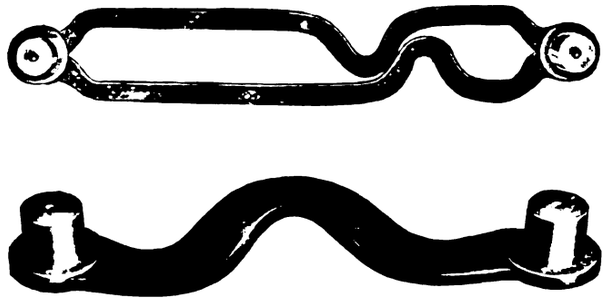
RAIL BONDS



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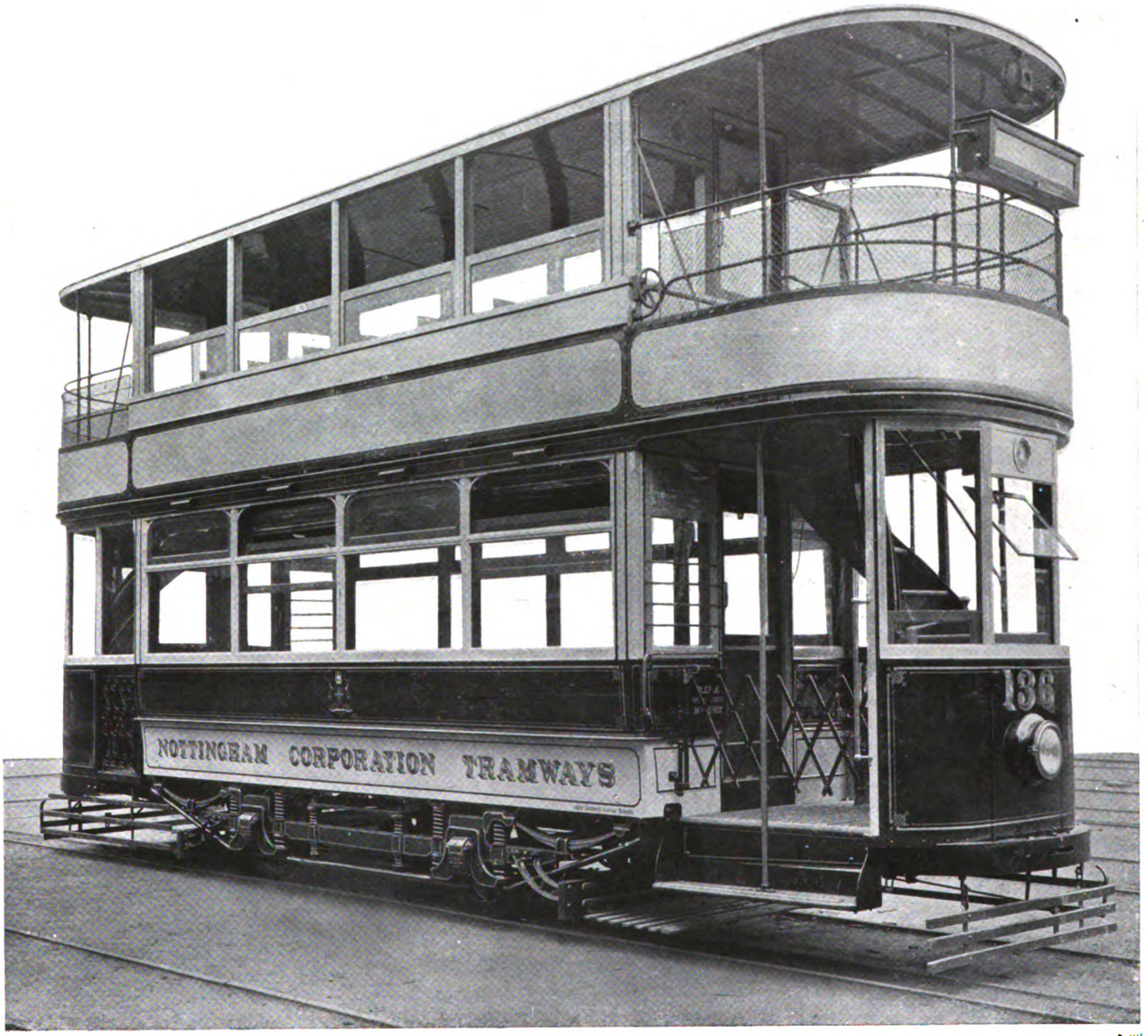
On the vestibules of this car the lower half of the centre light is fixed, while the upper half is arranged to pivot by means of a brass quadrant and to be fixed in any position up to an angle of 45°. The vestibule fronts are divided into 3 sections by mouldings to facilitate repairs.



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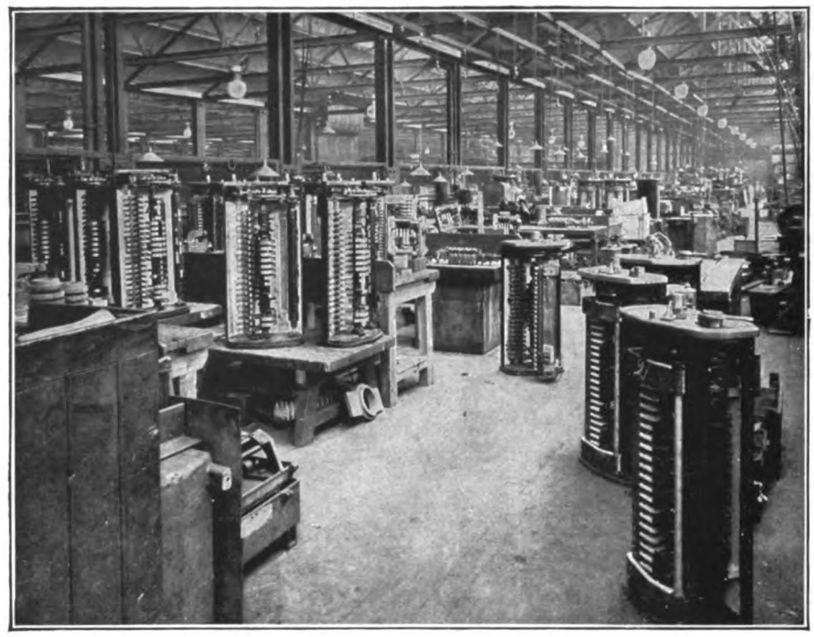

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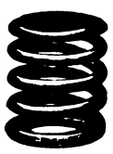

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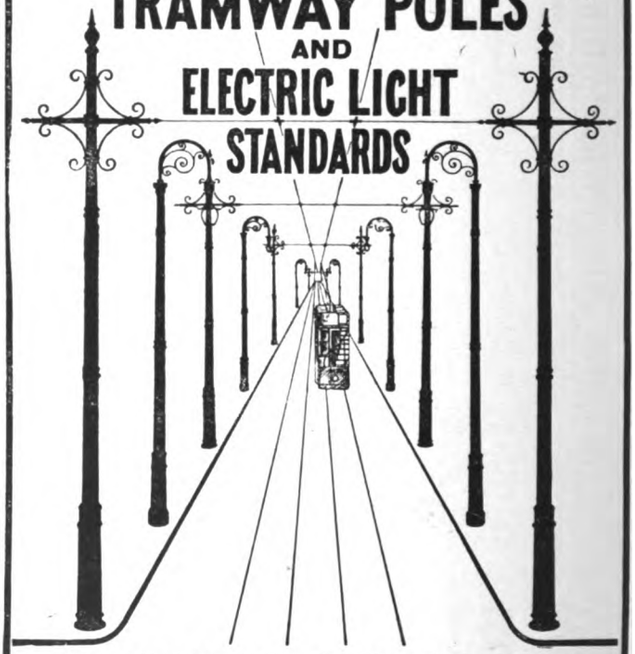

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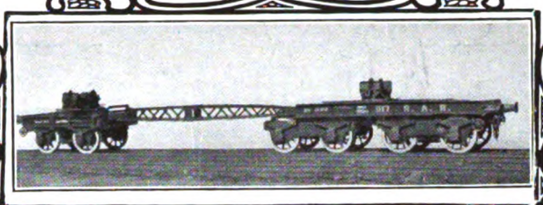

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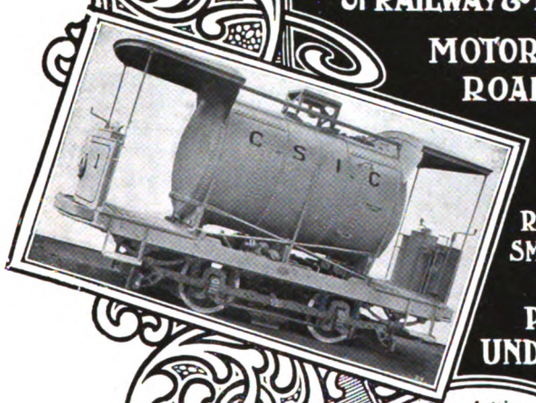

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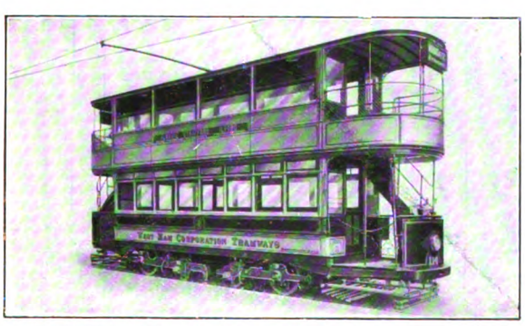

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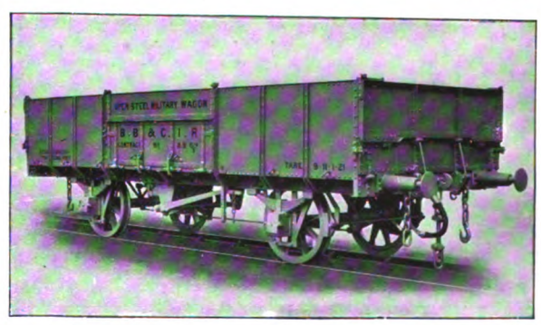

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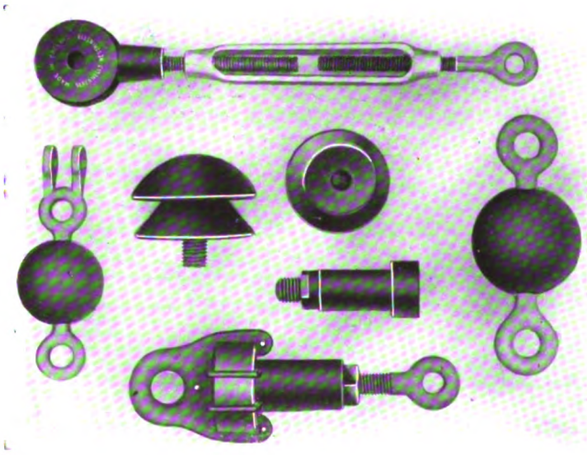

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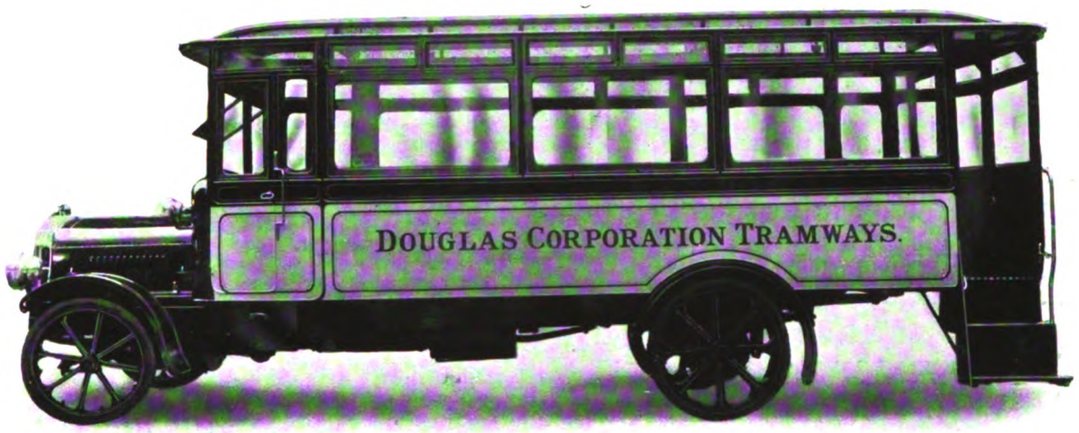

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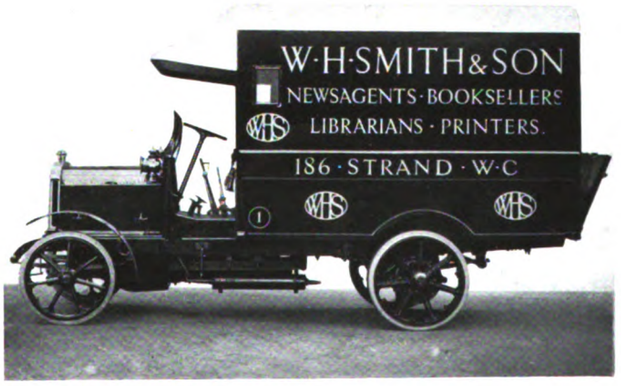

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Recognising this, responsible business men are already placing orders for Albion vehicles. These orders will be executed strictly in rotation as soon as the Government permits.

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Load Capacity 15 cwts. to 4 tons.

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A COMPENDIUM OF WEIGHTY JUDGMENTS

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"Scotstoun, Glasgow, 26th Feb., 1915.

"Dear Sirs,—For the past four years we have fitted a large number of Avon Solid Rubber Tyres to the different types of our motor vehicles, and the results obtained have been so satisfactory that we confirm having placed with you a further large contract for delivery during 1915.

"The Albion Motor Car Co., Ltd."

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"Leeds, Feb. 24, 1915.

"Dear Sirs,—We are pleased to inform you that Avon Solids have given us every satisfaction to date.

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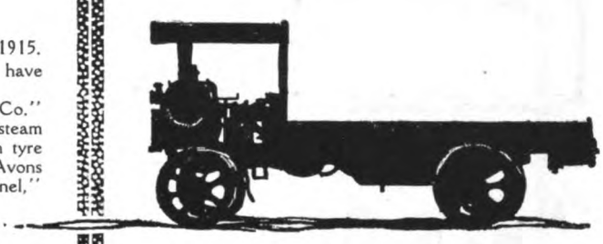
(In this case Avon Solids are being fitted to the Yorkshire 6-ton steam wagon, a powerful vehicle imposing the severest possible test on tyre strength and resiliency. Other well-known steamers to which Avons are successfully fitted are the "Foden," "Mann," "Sentinel," "Garrett," &c.)



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"A large number of these machines are being supplied with Avon Tyres, concerning which we are glad to be able to say we have had excellent reports and no complaints.

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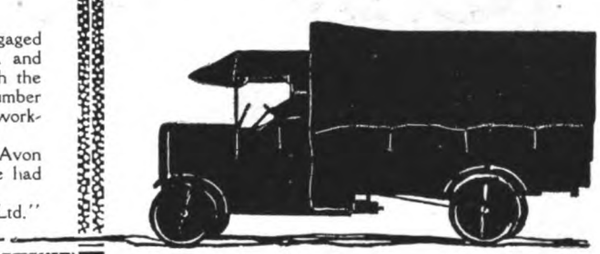

Business Motors yield maximum mobility and efficiency at lowest tyre cost per mile *only* when equipped with Avon Solids.

Every Owner or Transport Manager should write to-day for the Avon Solid Tyre Book—Post Free.

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Telegrams: "TICKETS, GLASGOW."

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"Yes, we use Glasgow Tickets."

May we send you some specimens? We produce tickets in any style, in any quantity, and print in any language.

Whenever you want tickets, either paper or pulp, we shall be pleased to quote you.

Freedom from ticket worry will be assured if you send your orders to

GLASGOW NUMERICAL TICKET & CHECKBOOK PRINTING CO.
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This Wonderful little Stamp Affixing Machine, 1915 pattern, if given a chance will sell itself, and in time pay for itself by the work it accomplishes.

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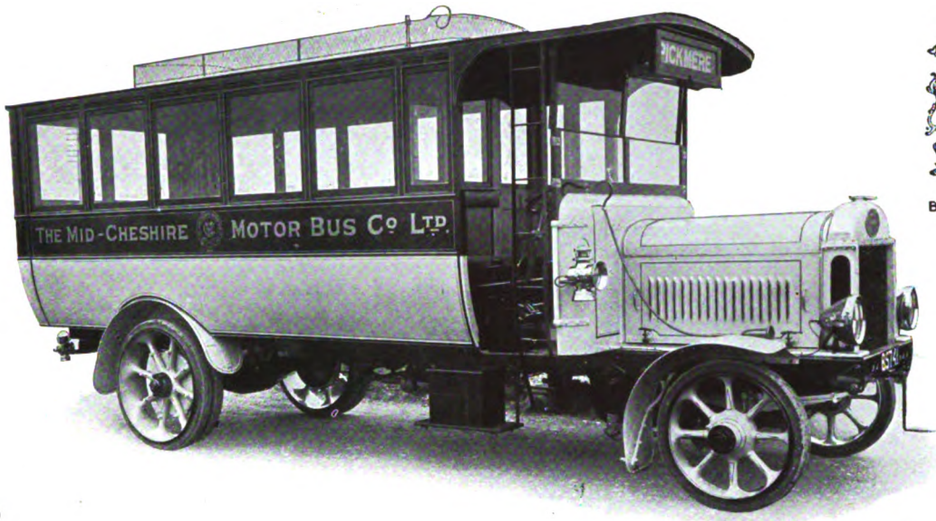

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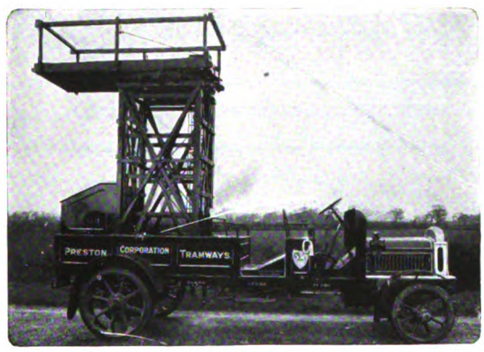
"LEYLAND" (STANDARD) SINGLE-DECK 'BUS TO SEAT 32 INSIDE.



STANDARD TOWER WAGON.

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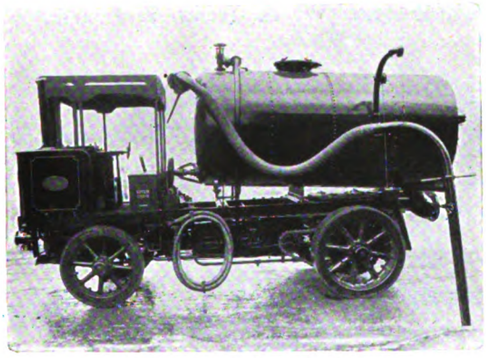

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LEYLAND MOTORS (1914) LTD.,

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OVER 30 MUNICIPALITIES EMPLOY HALLEY VEHICLES

RELIABLE AND DURABLE

TOWER WAGONS, TIPPING WAGONS
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Almost a quarter of the whole population of England and Wales is in and around London in the area served by the motor-buses.

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London is the richest city in the Kingdom. More than a quarter of the holiday makers that go to the seaside resorts must come from London.

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The motor-buses are always before them. Every one of the population uses them on an average 90 times in the year.

For rates and particulars write to the—

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TESTIMONY

Cleveland Motor Service, Ltd.,
Registered Office,
Great Ayton, Yorks.

Dear Sirs, *December 24th, 1914.*

The following facts will doubtless be of interest to you:—

Since June 1st last we have been driven, owing to War Office demands, to provide a THREE 'BUS SERVICE with a SINGLE 'Bus. The route is over fifteen miles each way, with four to five journeys per day—Sundays and Week-days—120 to 150 miles per day.

During the whole time we have only missed three journeys, these owing to carelessly tightened nuts in the leather couplings. Otherwise, we should have performed the whole of the 26,000 miles without a break or hitch.

Honestly, the Chassis and Engine have been a revelation in Mechanics—hence our further orders.

Yours faithfully,

For the CLEVELAND MOTOR SERVICE, LTD.,
(Sgd.) H. M. White,
Secretary and Managing Director.

Daimler

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But—the fact that we are making such deliveries—the knowledge that the Maudslay has been so widely selected by the War Office—is adding daily to the reputation of that vehicle.

Hence enquiries are persistent, and as all the orders that accrue must be dealt with in rotation, we suggest you open up negotiations **now.**

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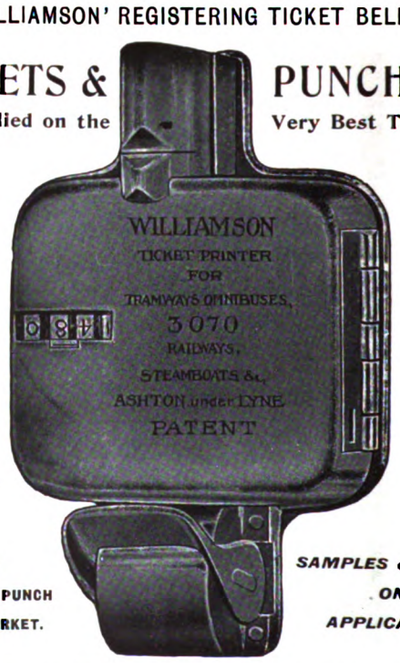

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This makes for shock absorption and, combined with the resilience which is a feature of the Wood-Milne, helps greatly to reduce engine wear and tear.

They are guaranteed for **10,000** miles but greatly exceed this distance. Indeed, on London 'Buses, where all competitive makes are represented, a mileage of over **80,000** has been reached, constituting a record.

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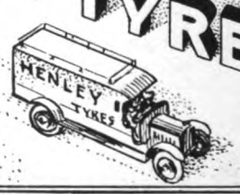

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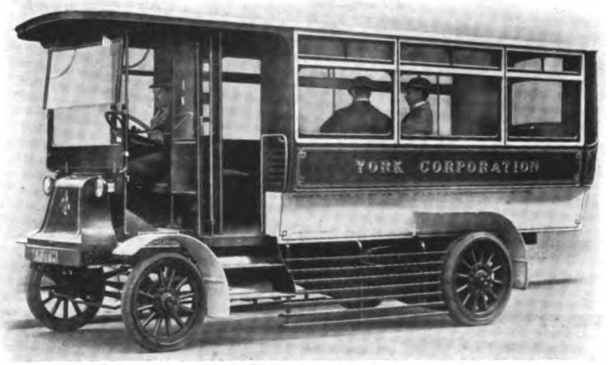

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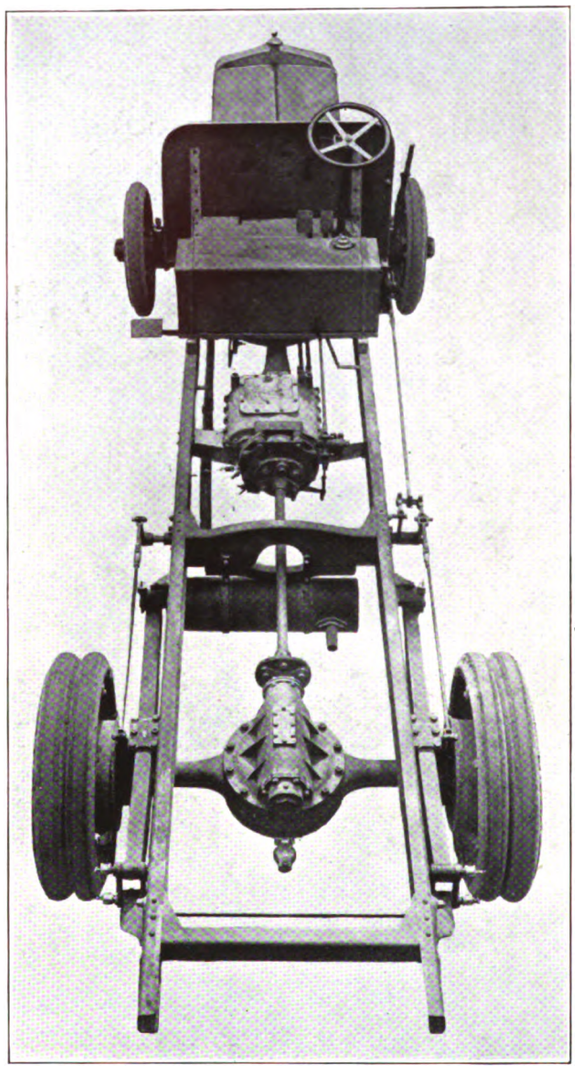

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Supplied to

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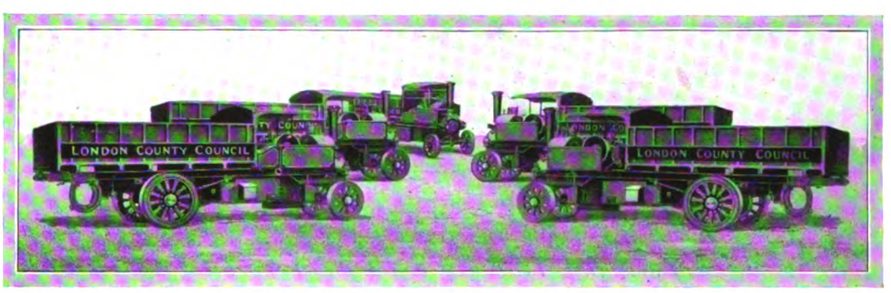

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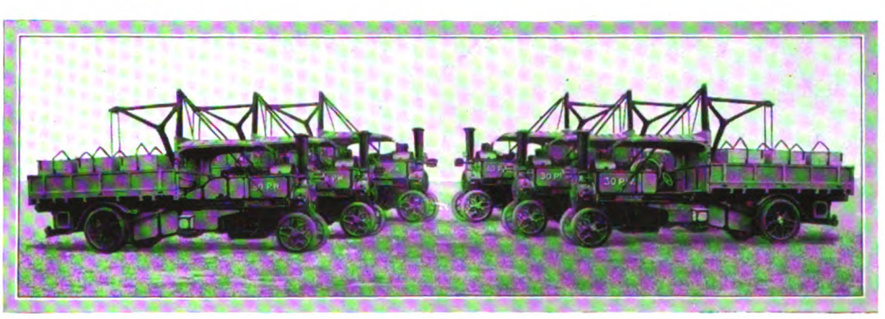

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PATENT WATER-TUBE STEAM BOILERS

11,100,000 H.P. Land Type for Stationary Purposes, 3,320,000 H.P. Marine Type Afloat.

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BABCOCK & WILCOX, LIMITED, also Supply as Joint Manufacturers and General Licensees with J. Samuel White & Co. Ltd., the White-Forster Boilers for Destroyers, Torpedo Boats, Pinnaces, etc.

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Twenty-four B. & W. Boilers, each of 4,780 square feet heating surface, fitted with superheaters and chain grate stokers.

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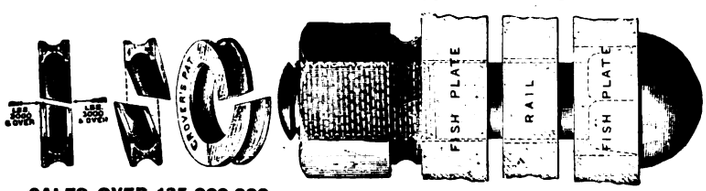
They are like the original in appearance only.



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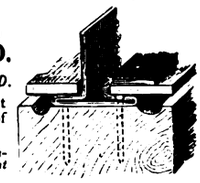

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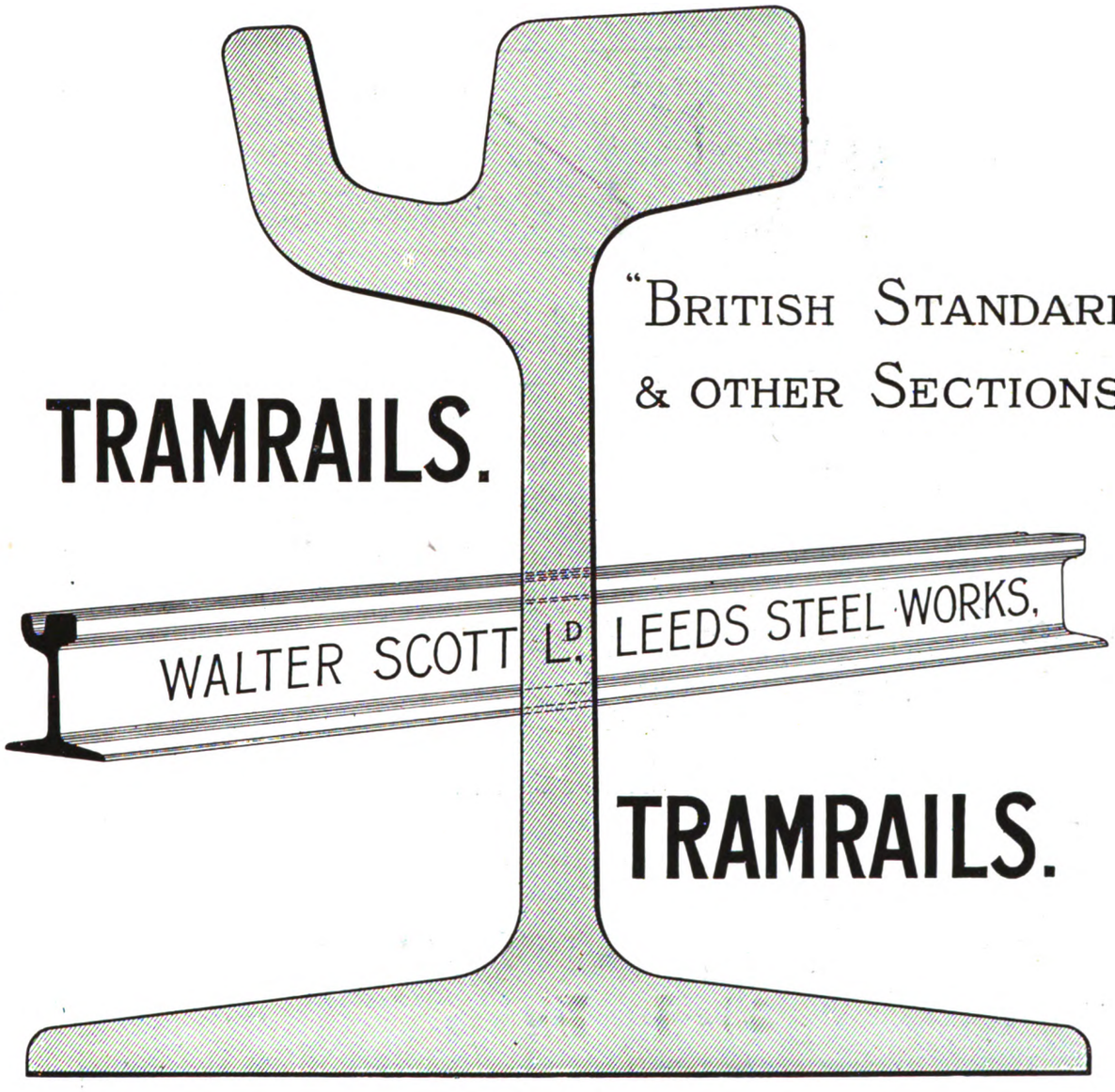

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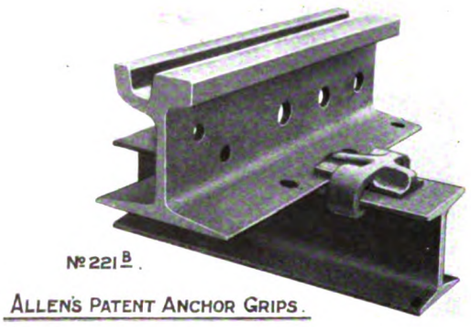

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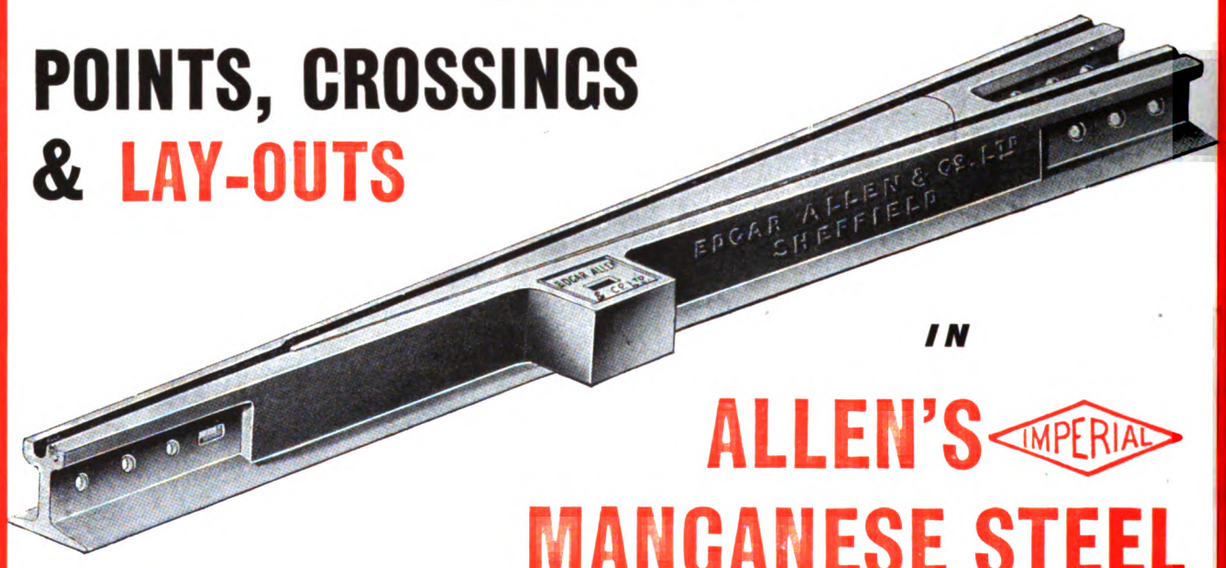

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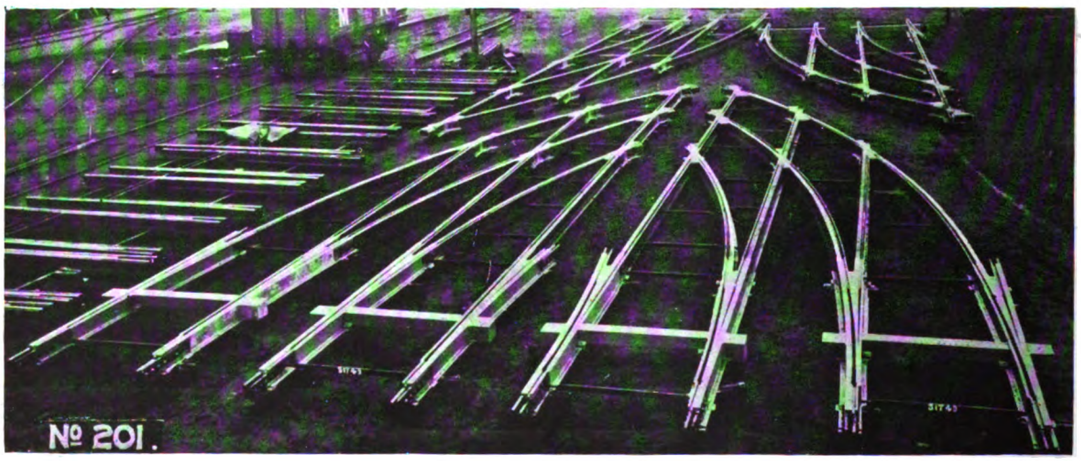

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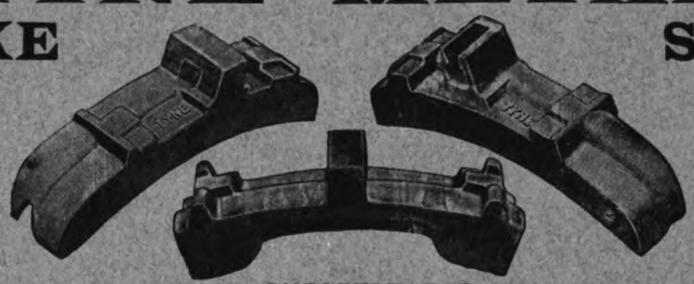

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